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Engineering News-Record

Building Some Large New Sewers in Detroit

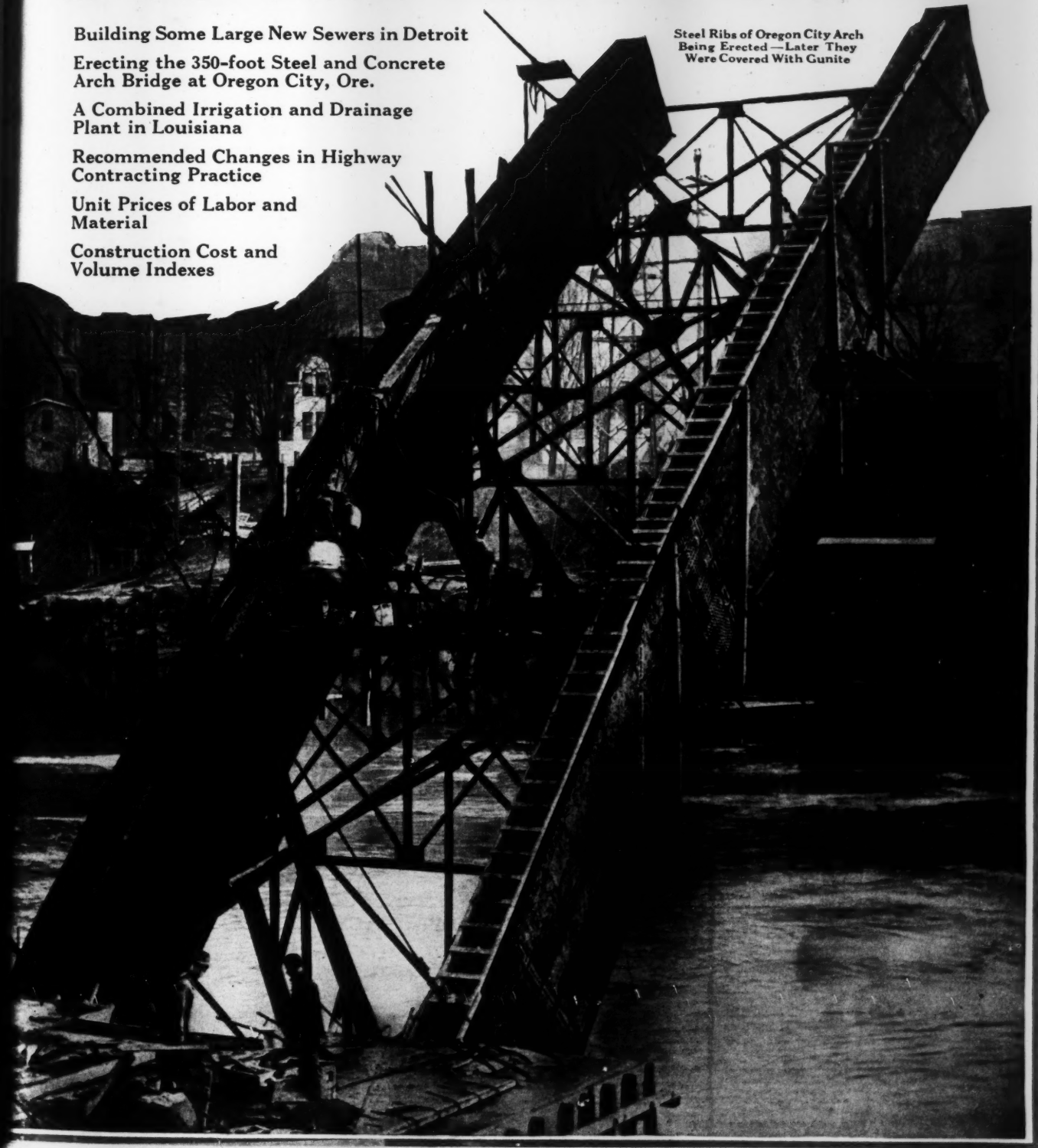
Erecting the 350-foot Steel and Concrete Arch Bridge at Oregon City, Ore.

A Combined Irrigation and Drainage Plant in Louisiana

Recommended Changes in Highway Contracting Practice

Unit Prices of Labor and Material

Construction Cost and Volume Indexes



Steel Ribs of Oregon City Arch Being Erected—Later They Were Covered With Gunite

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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

Volume 89 — NEW YORK, NOVEMBER 2, 1922 — Number 18

"The Living Wage"

WHEN it refuses to base a wage award on the theory of "the living wage" and labels that doctrine "a bit of mellifluous phraseology" the Railroad Labor Board speaks for the general public. It is time for someone to voice the impatience that has been aroused by the mischievous agitation of this appealing but impractical theory. Every decent American will sympathize with every effort to raise the standard of living for common labor, but nothing of the sort ever can be accomplished through a disregard of industrial stability, upon which depends the prosperity of all—including common labor. Arbitrarily to fix wages on the basis of estimated needs without regard to available earnings and competitive conditions would simply invite industrial chaos with consequent disaster to us all. However worthy our aspirations may be, no social good ever can result from our running amuck in the economic community.

William D. Uhler—Organizer

IN CREATING an organization excelled nowhere in America for state highway construction and maintenance, Col. William D. Uhler, whose death is announced in this issue, performed a task which ranks above his accomplishments in building great mileages of road—and he was equalled by few as a roadbuilder. Colonel Uhler conceived state road building and maintenance to be a great business continuing from year to year and requiring an organization for its direction comparable in ability and permanence with the organizations directing a great railway system or a great business corporation. In building up such an organization for Pennsylvania he went further, perhaps, than any other state highway engineer. To it as a model came highway officials from all the nations and none went away without example and inspiration which he could in some respect put to work in bettering his own organization practice.

Highway Contract Practices

HIGHWAY officials and contractors for road construction acting through their national associations have exhibited a disappointing inability to co-operate. Late in 1919 when the joint committee to consider contract practices was created by the Associated General Contractors and the American Association of State Highway Officials every indication was had that the action had the warm approval of the membership bodies of both associations. There is no reason to believe that this sentiment has altered, yet for almost three years the committee has failed to function in any constructive manner. No reports, beyond a perfunctory statement once a year of "progress," have been made. It seems high time to ask the reason for this failure. An answer is needed, particularly because rumors persist that intolerance within the committee is chiefly responsible. As the subjects for consideration have been formulated by contractors, as outlined in this issue, they are certainly not impossible of discussion in good temper. The committee will have another opportunity previous to the convention of the American Association of State Highway Officials in December to arrive at conclusions which will serve at least as a basis for discussion. It will, in fact, be disappointing if there is not a much more definite accomplishment to be reported.

Original Bridge Thought

THAT new things can be found even in so settled a practice as bridge engineering is demonstrated by the Oregon City arch across the Willamette River. As an article in this journal some months ago showed, the main span of this bridge is unique—a half-through arch of box girder section heavily coated with gunite. In this issue Mr. McCullough, the engineer in charge of the bridge, describes the novel scheme of erection wherein the old towers of suspension bridge to be replaced were used to carry the backstays for the cantilevered ribs of the arch and the old midspan roadway to support the crown sections of the new arch rib. It is not necessary to claim in either design or erection any epoch making advances to note that the care and study devoted both to the selection of type and the method of erection, with the novelty and utility of the final results, are testimony that bridge engineering need not be the cut and dried thing some of our British contemporaries fear it is becoming across the ocean.

A Doubtful Experiment

BEFORE this reaches most of our readers the voters of the state of California will have decided whether they are to enter into the most stupendous adventure in state ownership ever attempted in this country. Of late the proposition that the state control the water power within its boundaries has been advanced in a number of different ways and in many parts of the country but beyond a supervision of franchises and rates the idea has never been legalized. The constitutional amendment now before the California voters, however, goes further than any proposal heretofore made; it is in effect the complete ownership by the state of all water rights and power and, by extension at least, the entering of the state into many cognate businesses, such as the designing and building of all sorts of power plants, the sale of light and power and even the production of the machinery and material necessary to all of this. Economic and political history is against the desirability of such a move. In our early days of railroading it was attempted in many of the states, with such conspicuous lack of success that in most of the states where it was tried constitutional provisions were made against the state using its credit for anything but strictly governmental purposes. The advocates of the amendment would probably admit that California cannot profitably go into the railroad business but they would claim that the time and conditions

make water power a different kind of business for which the state is eminently suited. The facts and the prospects seem against such a view but in California it may prevail. If it does the citizens there will have the rather doubtful pleasure of serving as the testing ground of the most advanced experiment in state socialism these states have yet tried.

What of the New York Terminal Report?

IN JUNE, 1921, the National Association of Owners of Railroad Securities organized a Board of Economics and Engineering to investigate certain phases of the railroad situation. One of these had to do with the subject of joint terminals, and for immediate study the board selected New York and Chicago. In March of this year the association published the board's report on the Chicago problem together with its plan for unified control and operation of the terminals in that city. This report and plan were abstracted in *Engineering News-Record* of July 13. The board completed its work several months ago, but the association has not yet made public its findings with respect to the New York terminals. Although this investigation has been the enterprise of a private association, its subject is of great public interest, and we hope that the association will follow the same course with the New York report that it did with the one having to do with Chicago. The five engineers of whom the board was composed are eminently qualified to shed light on this complex subject, which means so much to the population and the industries, not only of New York, but also of those communities which depend upon it as their port of entry. The controversy that has raged concerning it has been materially complicated by local political considerations and it would be well worth while to have before us a technical and economic study conducted by competent engineers under the auspices of an organization with no political axes to grind.

How High Is a Dam?

VAINGLORIOUSNESS should not be charged against engineers, contractors, or owners who claim to have built or to own the highest dam, the tallest building, the largest elevated water tank or the biggest hydro-electric plant ever erected. The most that can be asked of such persons is that they make reasonably sure of their superlatives by a survey of possible rivals, with particular regard to exact basis of comparison. Confining the further discussion to dams, in view of Edward Wegmann's letter on another page on the highest dam in the world, it is pertinent to ask, "how high is a dam?"

Dimensions, capacities, weights, and the like may be compared in a variety of ways, depending upon the nature and object of the comparisons—whether a mere matter of bigness; or of difficulty in construction; or of the fundamental basis of structural design; or of function—to name only four bases of comparison.

Bigness has the broadest popular appeal and is perhaps oftenest used by engineers and certainly by contractors. Dam heights may very properly be compared from the lowest depths to which any part of the excavation and subsequent structure penetrates to the greatest height to which any part of the dam extends, provided the limitations are made clear. If one wishes to restrict at all, parapets may, as such more clearly extraneous objects as flagpoles must, be excluded; but why should not the 3-ft. parapet of the Arrowrock dam with its length of 1,100 ft., be included in the overall height of that towering structure, thus making it 351.7 ft. from the lowest point in the foundation to its highest masonry work?

Difficulty of Construction legitimately calls for overall heights, both for the reason just indicated and because the deeper and the higher a dam goes the greater the difficulty and the unit cost. This is true even though in each mere volumes may be rapidly diminished. If it be argued that a mere pocket, perhaps only a few square yards or feet in area, may add materially to the height of dam but be of little real consequence in material, labor, difficulty or cost, it may be answered that in some cases the contrary is true, but that no limiting line can be drawn and that all true comparison is lost if deep penetration is added to the total height in some cases and omitted in others.

Fundamental Basis of Design is vitally affected by not only the overall heights of dams, but also by other factors well known to the dam engineer. These call for several different standards of height comparison, some of which involve the height of the dam in its relation to elements of possible destruction, as crushing weights on the one hand and on the other weight as a resistance to overturning or sliding, and depth of the water behind the dam in terms of pressure tending to cause sliding, overturning, vertical rupture or lifting. Although water depths and pressures are not strictly different ways of expressing dam heights yet some of these possible bases of comparing heights of the dam structure follow the need for considering water depths in dam design. The extent to which the various governing elements in design vary with different materials of construction (masonry alone having been in mind thus far) and types of sections need only be mentioned here, except to note such special factors in the design of earth dams as the vertical distance between water surface and the intersection of the lower slope with the lowest point of the natural bed of the stream in relation to saturation effects.

Functionally, dam heights are mainly concerned with the head they afford for water power since the volume of water stored depends also upon average depths and total flooded areas of reservoirs. It is common to report maximum water depth against the dam but as regards both power head and available storage the real factor is the distance from water surface to power penstock or water-supply conduit.

Summing up, there are numerous perfectly legitimate bases for comparing heights of dams, according to the main object of the comparison. In some cases it may be desirable to use more than one basis. The most common and natural desire is to compare structural bigness, or total height. For this purpose it is hard to answer the argument for using the distance between the extreme points of depth and of height, the latter perhaps more generally, but not of necessity always, stopping at the crest of the dam or at the crest of the wing wall in the case of overflow dams. The point always to be observed is that in any given set of comparisons the same method should always be used and that basis should be clearly defined.

So much for "How high is a dam?" As to which is the highest dam in the world, the question asked by Mr. Wegmann, if answered from the most common standard of bigness or gross height, is that the Arrowrock Dam still overtops all others.

Three Score Years and Ten

SEVENTY years ago the fifth of November, twelve men met in the office of the Croton Aqueduct Department in New York City "for the purpose of making arrangements for the organization, in the city of New York, of a society of civil engineers and architects." Alfred W. Craven, uncle of the present distinguished engineer of that name, presided. In that meeting was born the American Society of Civil Engineers, now the oldest American national engineering society and, except for the Boston Society of Civil Engineers, the oldest of all our engineering societies. So, on this anniversary, marking the scriptural allotment of life to the individual, it is appropriate that we pause long enough to look back over the road the society has traversed.

In 1852 American engineering was young. Railroad practice was in its infancy, the structural engineer still looked to the forest for his materials, the sanitary engineer had scarce come into being, and the builder of water-works never had heard of principles and processes that today are commonplaces to the engineering undergraduate. In its technical aspect, our profession was restricted in scope and of meager substance. But in their conception of the professional spirit and in their understanding as to the needs of the infant profession, the twelve founders were splendidly endowed. With sure discernment of what is fundamental and enduring, they announced the first purpose of the new society to be "the professional improvement of its members." Then followed "the encouragement of social intercourse among men of practical science, the advancement of engineering in its several branches, and of architecture, and the establishment of a central point of reference and union for its members." Today, after the lapse of a lifetime, the constitution of the society still sets forth its objects in language almost identical with that of the founders.

In its pursuit of these ends the American Society of Civil Engineers became the major influence making for the unity and the advancement of American civil engineering and for the development of a professional consciousness in its practitioners.

It has contributed to the advancement of engineering science by providing a forum in which have been discussed the problems that have confronted the civil engineers of America during seventy years. Its special committees have reported to the profession on technical questions of far-reaching importance. It has forwarded engineering research and has contributed to the establishment of engineering standards. It has stimulated technical discussion by providing medals and prizes to encourage participation by all who might contribute helpfully, and it has honored appropriately those who have attained eminence in the profession. Its papers and *Transactions* comprise a technical treasury of unparalleled worth, valued wherever English-speaking engineers may be found. They are a veritable chronicle of the golden age of engineering.

The society has established and maintained the "central point of reference and union" that for seventy years has been a professional home for its members, however far afield they may have been scattered by the exigencies of their calling. For thirty-six years it occupied its own house, and since 1917 it has been part proprietor of the Engineering Societies Building, the engineering capitol of the nation. Of its library, containing in 1916 more than 89,000 documents, 67,000 were not duplicated in the collections of the other Founder Societies and were incorporated in the joint library of the United Engineering Society. Today, in co-operation with other national engineering associations, the society contributes toward the maintenance of a "central point of reference and union," for the profession in all of its branches.

It has "encouraged intercourse among men of practical science," not in America alone, but throughout the world. It has taken an active part in three international engineering congresses that have been held in the United States, and in addition to these, has held four of its conventions outside our national boundaries; two in Canada, one in England, and one in Mexico.

Of recent years the society has directed increasing attention to the encouragement of intercourse between its members dispersed throughout the country and between those members and the society headquarters. It has inaugurated the holding of general technical meetings at various points and has encouraged and fostered the development of local sections. While all that might be done to help the local sections has not yet been achieved, the deficiency has been chargeable to inadequate resources rather than to any lack of sympathy with their needs. Even in the beginning, the founders understood how necessary it always would be to keep alive in each member, the conviction that the society is *his* society, and thereby to avert the blight of sectionalism with its complementary fear of over centralization. The local sections have been evolved to meet this need, and until their success has been assured the society continues to count their welfare as among its chief concerns.

But foremost among the services the American Society of Civil Engineers has rendered to the profession is the "professional improvement of its members," for therein lies the distinctive characteristic of a profession. Ambition for self-improvement is the mark of the professional spirit; and this applies with equal force to the manual craftsman and to the intellectual worker. High or low, wherever we may find him, the man of professional instincts is building something of himself into his work out of sheer love for it and because of an instinctive urge to be of service to his fellows. In maintaining high standards of membership and in upholding faithfully these professional ideals, the society has rendered its greatest service, not only to the profession but also to the community of which it is a part. For the community has learned that the name and the influence of the American Society of Civil Engineers never is found in support of any project not in keeping with those ends.

Such is the record of three score years and ten. And *Engineering News-Record* offers to the American Society of Civil Engineers its warmest congratulations on the fullness of its years, the excellence of its craftsmanship and the worth of its ideals. But most of all, we congratulate it on the opportunity that lies before it to serve the profession with equal fidelity in the solution of the problems that now beset it. May those who guide its destinies for the next seventy years be endowed with a measure of the same vision and the same wisdom, and above all be governed by the same high purposes as were those responsible for its present estate.

Old Suspension Bridge Used in Erecting New Arch

Main 350-ft. Ribs of New Highway Bridge at Oregon City, Ore., Swung Into Place by Means of Cables of Bridge Being Replaced—Other Erection Methods Studied

By C. B. McCullough
Bridge Engineer, Oregon State Highway Dept., Salem, Ore.

IN THE erection of the 350-ft. steel arch bridge across the Willamette River at Oregon City, Ore., several different schemes for placing the large arch ribs were studied and the one selected seems to be unique in bridge erection, namely utilizing the old suspension bridge at the site to carry the sections of the ribs until the arch was closed. The adopted method and the alternate schemes are the subject of this article, together with some notes on the foundations.

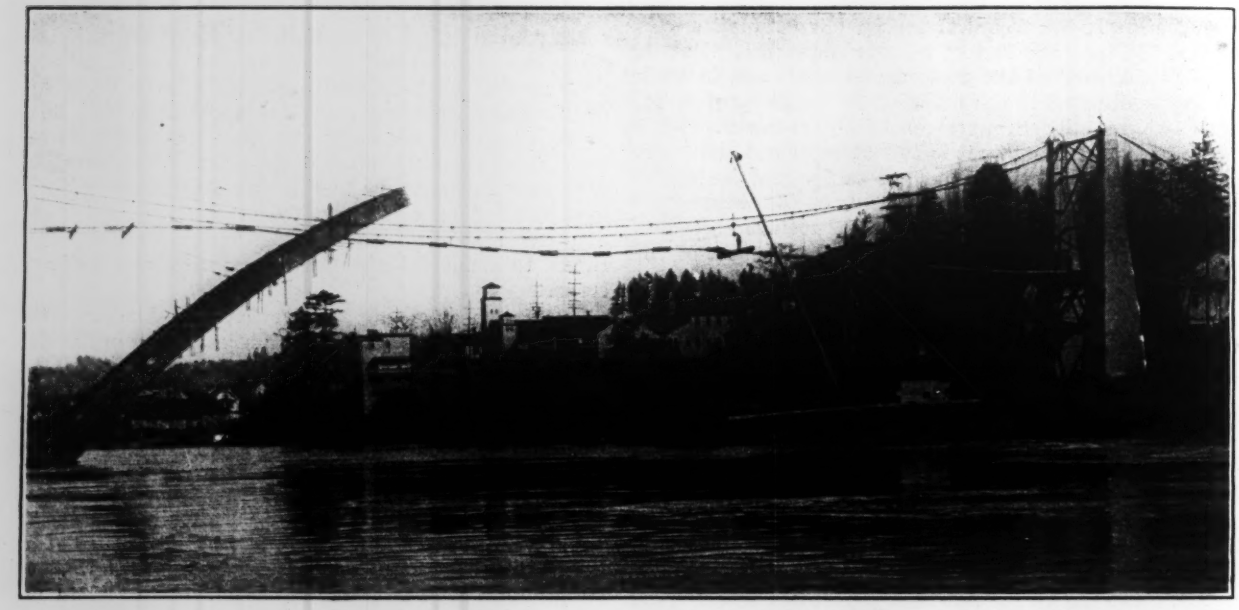
The Oregon City bridge, as described in *Engineering News-Record*, June 8, 1922, p. 942, has as a main span a steel arch 360 ft. between pier centers and 350 ft. between skewbacks, with a 5 per cent grade roadway halfway up the arch so that it is suspended at the center and supported by posts at the ends of the arch. The ribs are 22 ft. center to center and are each of box-girder section, which at the springing line is filled with concrete and which is covered with concrete applied by cement gun. Erected as a three-hinged arch, the hinges are replaced after erection by through splices.

The main channel of the Willamette River at the site of this crossing is nearly 100 ft. deep which fact precluded the consideration of false work in the channel, thus rendering it necessary to adopt some other method of erection. The several different schemes considered in this connection are shown in one of the drawings and may be described as follows:

Alternate Methods—Scheme A—Falsework on floating barges and a battery of hydraulic jacks for elevation adjustment. Since a program of this kind could only be employed during the summer season (owing to the severity of fall flood water conditions), this scheme could not fit in with the program of operations demanded by the time limit on the job. This scheme was never seriously considered by any of the contractors bidding upon the work.

Scheme B—This schedule contemplated the erection of section 1 of the rib, the construction of the abutments or piers and the subsequent erection of sections 2, 3, 4 and 5 from a derrick placed on top of the piers. The floor stringers in this case were to be employed as a temporary anchorage and the balance of the work (sections 6, 7, 8 and 9) placed with the derrick moved out to the end of the temporary cantilever.

Schemes C and D—Both of these schedules contemplated the erection of one-half of the arch rib in one operation. Scheme C contemplated first the placing of the lower section (section 1), next the erection of the piers and a timber erection tower surmounting the same. One-half of the balance of each rib was to be riveted up next and floated to the site in "position No. 1," raised by jacks to "position No. 2" and connected at the lower erection pins. Each rib was then to be raised to a position sufficiently above the true position to allow the other half span to clear when raised; and subsequently, the two sections were to be lowered simultaneously and pinned at the center. Scheme D was somewhat similar except for the fact that lifting was to be done from a



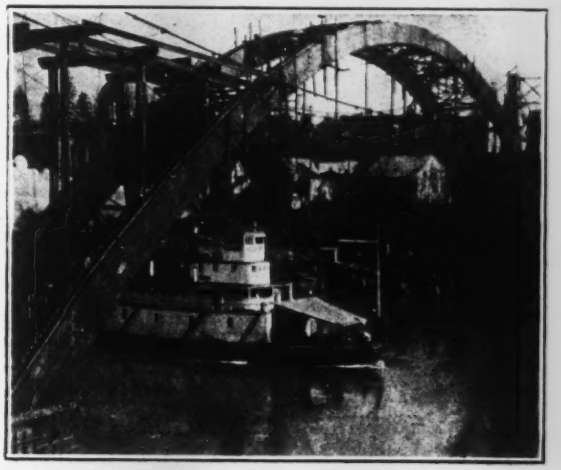
GENERAL VIEW OF OREGON CITY ARCH UNDER ERECTION

Rib sections are held in place by stays from towers of old suspension bridge being replaced. Old footway used for temporary construction crossing. The main channel of the Willamette River at the site of this crossing is 100 ft. deep.

vertical tower on a large barge at the center, thus dispensing with a shore line for lifting. In this scheme, the entire half span including lateral bracing was to be lifted at one operation.

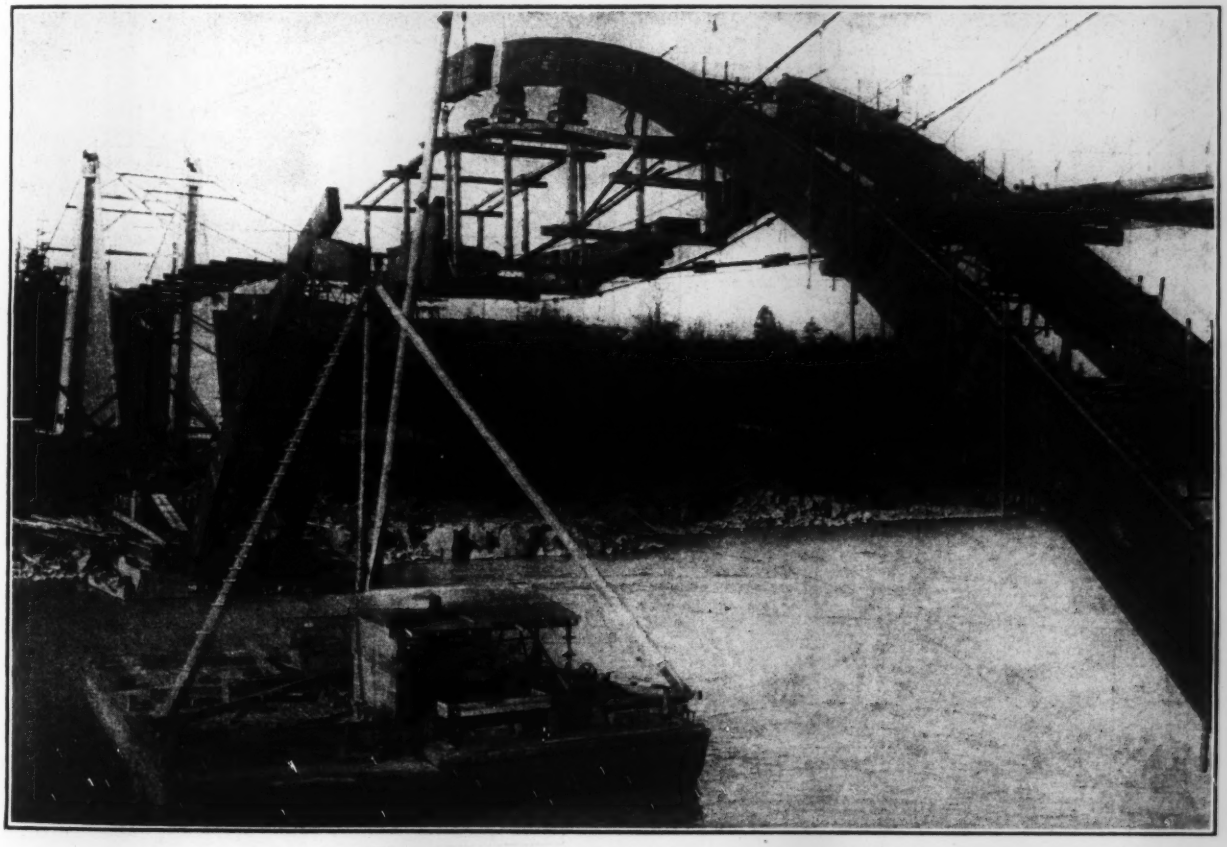
Method Adopted—Utilizing the cables of the old suspension span. The erection schedules described hereinabove were worked out in the office of the State Highway Department, and submitted to the erectors upon request before bids were taken. The successful bidder, however, proposed a fifth scheme which was finally approved and adopted for the work. This erection schedule was worked out by the firm of Gerrick and Gerrick, of Seattle, Wash., who were sub-contractors for the erection and is largely the work of A. Münster, of Seattle, who was retained by the above firm as consulting engineer. This scheme utilized the main cables and towers of the old suspension span (which was to be replaced by the present structure) for the support of rib sections.

Rib sections No. 1 at either end were first placed on the skewback support by means of a barge derrick. These sections were rested on a temporary erection hinge and held to position by means of a radial cable passing upward over the old suspension bridge towers and back to an anchorage on the approach. Sections 2, 3, 4, 5 and 6 were successively placed, each rib section being held by radial cables passing over the towers and down to the anchorage. One of the photographs shows six rib sections on the left held in this manner and the fifth section on the right being lifted from the scow for placement.



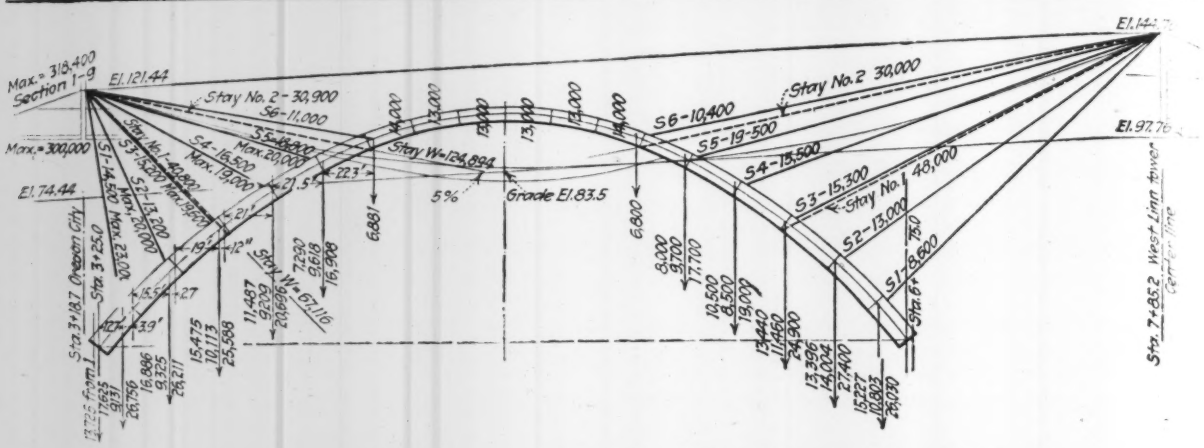
OREGON CITY ARCH RIB SWUNG INTO PLACE

There is also shown herewith a graphic analysis of cable stresses which is self-explanatory. Although each radial cable was amply capable of sustaining the maximum stress induced therein by virtue of the rib loads, it was considered the part of prudence to require the use of auxiliary *stay* cables to insure against overstress in any one of the radial cables due to a breakage or any undue deflection in any of the others. The graphic analysis indicates the scheme first outlined and contemplates the use of *two* stay cables for each cantilever; one at the



PUTTING CROWN SECTIONS OF RIB IN PLACE ON OREGON CITY ARCH

Old cables being used to carry rib sections prior to swinging in place. Haunch sections stayed back to suspension bridge tower. Crown sections built up on falsework on cables.

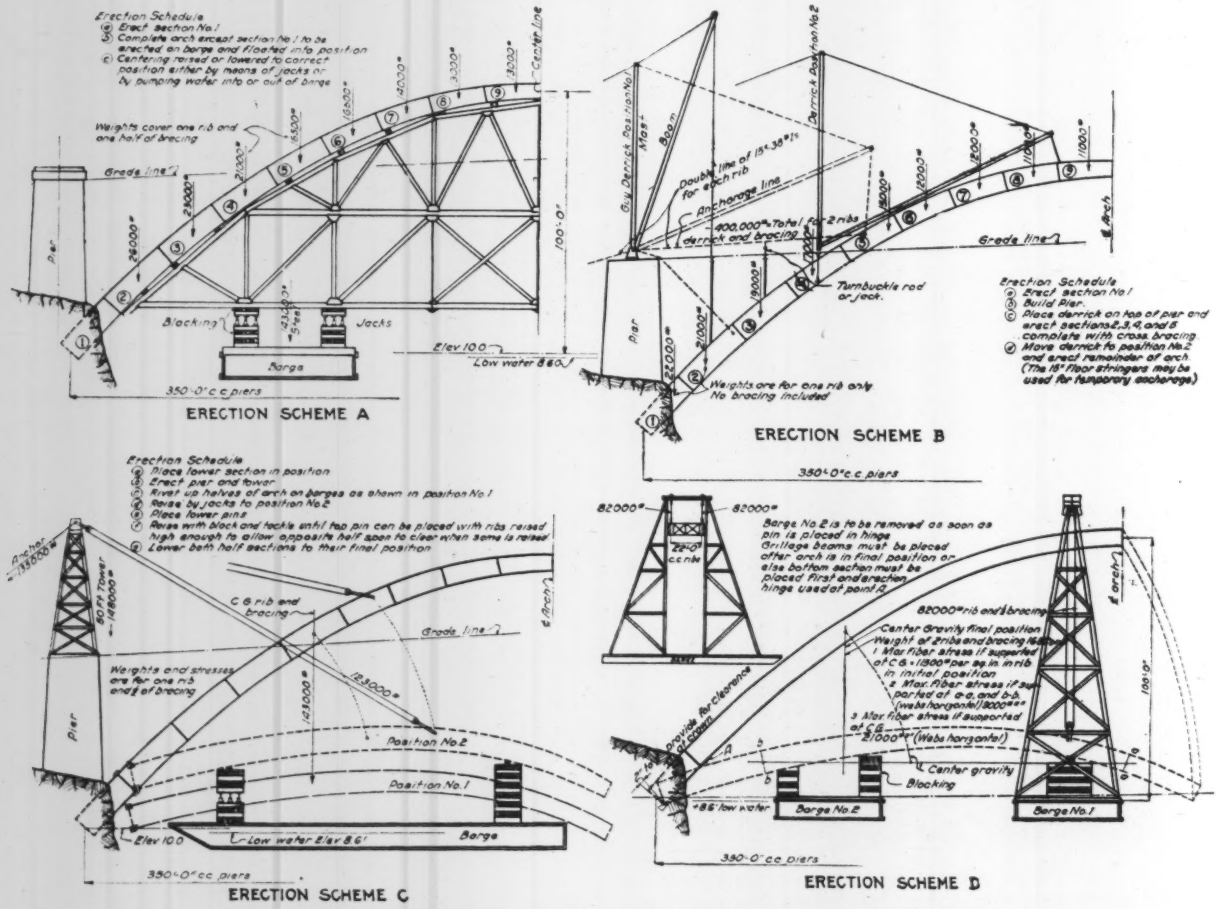


GRAPHIC REPRESENTATION OF THE CABLE STRESSES IN ERECTING THE ARCH

extreme end of section 3 and one at the extreme end of section 6. These stay cables were designed to carry the entire six rib sections independently of cables, S1 to S6 inclusive. The two stays shown were afterwards discarded in favor of one heavy stay cable at the end of section 4.

The central portions of the rib span (sections 7, 8 and 9) were placed on timber bents carried directly on the main cables of the old suspension span. One of the views shows the construction of these bents, the last section being placed at the time of the taking of this photograph. There is also a view of the completely swung rib with the central falsework removed from the main cable and a portion of the column and floor steel in place.

Tests of material cut from the main cable made in the laboratory at the time of erection disclosed an ultimate strength of 157,000 lb. per square inch. This, with an area of 13.85 sq.in., gave a breaking load of 2,174,450 lb.; while the maximum erection load under

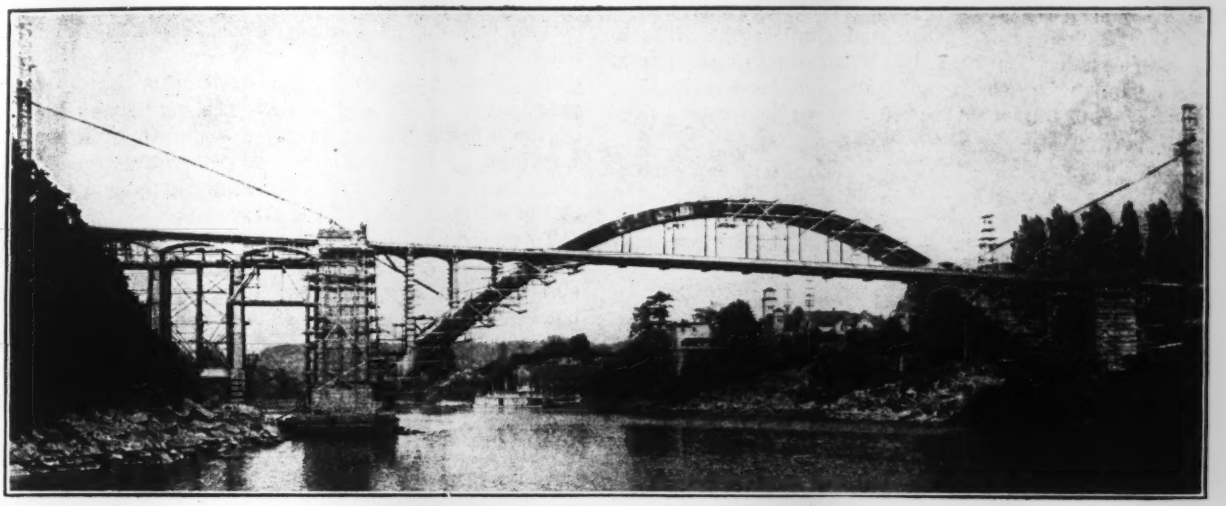

Erection Schedule
Erect section No.1
Complete arch except section No.1 to be erected on barge and floated into position
Centering raised or lowered to correct position either by means of jacks or by pumping water into or out of barge
Weights cover one rib and one half of bracing
Grade line
Pier
Blocking
Jacks
Barge
Elev 10.0
Low water 8.6
350'-0" c.c. piers
ERECTION SCHEME A
Guy Derrick Position No.1
Derrick Position No.2
Mast
Double line of 1 1/4" ϕ for each rib
Anchorage line
400,000# Total for 2 ribs derrick and bracing
Turnbuckle rod or jack.
Weights are for one rib only No bracing included
Erection Schedule
Erect section No.1
Build Pier.
Place derrick on top of pier and erect sections 2, 3, 4, and 5 complete with cross bracing.
Move derrick to position No.2 and erect remainder of arch. (The 15" floor stringers may be used for temporary anchorage.)
ERECTION SCHEME B
Erection Schedule
Place lower section in position
Erect pier and tower
Rivet up halves of arch on barges as shown in position No.1
Raise by jacks to position No.2
Place lower pins
Raise with block and tackle until top pin can be placed with ribs raised high enough to allow opposite half span to clear when same is raised
Lower both half sections to their final position
Anchor
80 Ft Tower
C.G. rib and bracing
Grade line
Weights and stresses are for one rib and ½ of bracing
Position No.2
Position No.1
Elev 10.0
Low water Elev 8.6'
Barge
350'-0" c.c. piers
ERECTION SCHEME C
82000#
Barge No.2 is to be removed as soon as pin is placed in hinge
Grillage beams must be placed after arch is in final position or else bottom section must be placed first and erection hinge used at point A
82000# rib and bracing
Center Gravity final position
Provide for Clearance of Counterweight
Center gravity
Blocking
+8.6' low water
Barge No.2
Barge No.1
350'-0" c.c. piers
ERECTION SCHEME D

ALTERNATE METHODS STUDIED FOR ERECTION OF OREGON CITY ARCH

the worst condition amounted to 351,000 lb., thus giving an ample factor of safety. The radial cables were 1-in. plow steel having a breaking load of 38 tons. The stay cables were of 2-in. plow steel having a breaking strength of 140 tons.

In order to eliminate the difficulty of blocking the center sections to correct elevation, which would be caused by the varying deflection in the main cable, the six center sections were first loaded onto a platform between the bents and supported by the main cables causing the cable to take its final (or nearly final) position before the bent blocking was placed.

After the rib was swung, a portion of the remaining dead-load was added to the structure acting as a three-hinged arch. Subsequently, the ribs were fixed at crown and at skewback thereafter acting under live-load and the balance of the dead-load as fixed arch ribs.



VIEW OF BRIDGE IN LATER STAGES OF COMPLETION

Foundation Work—Some of the details of the construction of the main piers are worth describing. These foundations were on solid basaltic rock, one abutment being entirely in the dry and the other in about 8 ft. of comparatively still water. No problem out of the ordinary was presented by either foundation, the wet abutment being concreted in the dry through the unwatering of a double wall puddle cofferdam of ordinary type. Core drillings were taken for a distance of from 25 to 35 ft. below the surface to disclose the presence of any seams or pockets in the foundation material. The drillings, however, indicated nothing of this kind, yielding a very uniform and continuous core. Tested in the laboratory, these core specimens gave the following results:—

Maximum compressive strength —
15,300 lb. per sq.in. = 1,101.6 tons per sq.ft.
Minimum compressive strength —
11,050 lb. per sq.in. = 795.6 tons per sq.ft.
Average of maximum and minimum strength —
13,175 lb. per sq.in. = 948.6 tons per sq.ft.

In view of the fact that the resultant base pressure on the abutment, even under the worst possible live-load condition, falls within the middle third of the base and that the maximum extreme toe pressure amounts to but 4.9 tons per square foot, this type of foundation leaves little to be desired. The base rock was lightly shot and about 2 ft. of material removed in order to roughen the surface and remove any shattered or slightly seamed surface material and concrete placed thereon in the dry.

Personnel—Contract for this structure was awarded in June, 1921, to A. Guthrie & Co., Inc., of St. Paul and Portland, and construction work begun during the following July. The schedule of erection herein outlined operated with the utmost satisfaction to all parties concerned and from start to finish the program was carried through without a hitch. Credit for the admirable solution of the many erection problems encountered is due to the excellent engineering staff maintained by the contractors' and sub-contractors' organizations, to A. Münster, their consulting engineer, and to R. A. Furrow and C. P. Richards, who were in charge of the construction work for the Oregon State Highway Department, by whom the bridge is being built.

Canadian Canal Traffic Shows Increasing Tonnage

The July summary of Canadian canal statistics issued by the Dominion Bureau of Statistics, shows increased traffic in nearly every case. Total traffic through the Canadian and American locks at Sault Ste. Marie increased more than 26 per cent, over July, 1921, and also over June, 1922. The large increases were in wheat and iron ore; the latter totalling 8,942,659 tons, compared with 4,356,760 tons in July, 1921; 9,235,086 tons in July, 1920, and 8,912,609 tons in July, 1919. Wheat shipments for the month were 17,777,377 bushels as against 7,838,878 in July, 1921; 7,838,470 in July, 1920, and 7,100,008 in July, 1919. Coal shipments continued light.

Welland canal traffic showed a slight decrease from July, 1921, mainly in soft coal shipments and in American corn. Wheat shipments increased 191,291 tons or 6,376,000 bushels, while barley, iron and steel and pulpwood also showed increases.

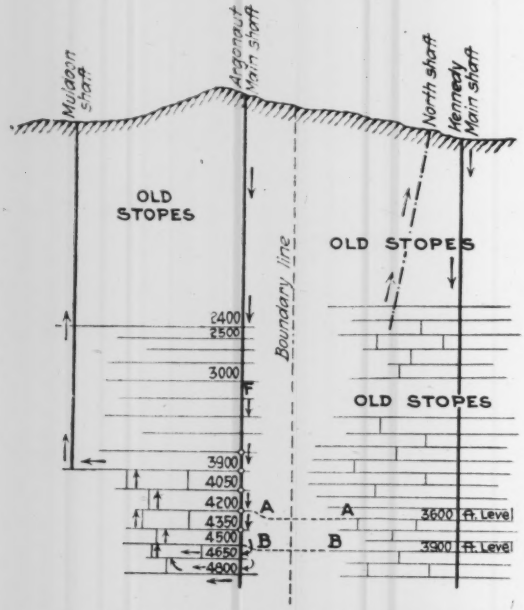
On the St. Lawrence canal passenger traffic increased more than 44 per cent over that of July, 1921. Freight traffic also increase 23,256 tons or 4 per cent despite large decreases in coal and in corn and oats. Wheat, iron and steel, pulpwood, lumber and timber all showed substantial increases.

The Argonaut Mine Disaster

A Review of the Conditions and Events that Led to the Death of Forty-seven Men, Trapped by Fire in Main Shaft

SO WIDESPREAD an interest was aroused by the three weeks' struggle to reach the forty-seven miners imprisoned in the Argonaut mine in California and so fragmentary have been the accounts available in the lay press that *Engineering News-Record* has prepared the following brief story of the accident, drawing freely upon the more detailed accounts published in *Engineering & Mining Journal-Press* of Sept. 23, Sept. 30, Oct. 7, and Oct. 14.

The Argonaut mine is situated a mile north of Jackson in Amador County, Calif., about ninety miles northeast of San Francisco, and taps the Mother Lode, a gold-bearing formation that runs along the western slope



SECTION OF ARGONAUT AND KENNEDY MINES

These are the principal workings only, projected on a vertical plane. The fire started at point F. The arrows indicate the ventilation and the small circles at the intersections of main shaft and levels indicate doors to stop draft. A-A and B-B indicate the lines of approach for the rescue parties from the Kennedy mine.

of the foothills of the Sierra Nevada. Its workings extend to a depth of 4,275 ft., while those of the Kennedy mine, which adjoins it, are carried to a depth of 4,150 ft., part of this difference being due to the fact that the rim of the Argonaut shaft is 112 ft. higher than that of the Kennedy owing to the contour of the ground. The main shafts of the two mines are 1,100 ft. apart.

The accompanying diagram, which shows the workings of the two mines projected on a vertical plane, will make clear the lay of the land. The main shaft of the Argonaut mine is sunk on an angle, which makes it about 4,885 ft. long. The Kennedy shaft is vertical. Each mine has a secondary shaft, that of the Argonaut being designated the Muldoon shaft. This is 450 ft. south of the main shaft and has a hoist that can be operated to a depth of 800 ft. only. Below that, the shaft as far as the 3,900 ft. level is but a system of linked raises equipped with ladders. The bottom level, 900 ft. deeper, is similarly reached by means of the raises that connect the successive levels on the south side of the main shaft. The main shaft is used for hoisting and pumping and by means of it the miners go to and return from their work.

Ventilation of the mine is effected by a fan at the Muldoon shaft, which draws the air down through the main shaft, through the workings and out through the Muldoon shaft. This matter of ventilation should be noted carefully as it had a considerable bearing on the accident and has given rise to controversy over the responsibility for the fatalities.

In order further to direct the fresh air into the bottom workings, the upper levels, where they connect with the shaft, are closed by doors. The location of these doors is shown by the small open circles at the junctions of shaft and levels. The ventilating system of the Kennedy mine forms a separate unit, as the workings of the two mines do not connect, although some leakage of air from the Kennedy is said to exist at the 4,200-ft. level of the Argonaut.

To understand more fully the conditions surrounding the accident, it is necessary to know that the managements of the Argonaut and Kennedy properties have not been good neighbors. If they had been on friendly terms it is probable that communication between the workings of the two mines would have been maintained with a joint system of ventilation that might have gone far toward averting the serious consequences of the disaster. The latest controversy between them grew out of a fire in the Argonaut workings in March, 1919, which spread into the Kennedy mine through ventilation connections existing at that time. After it had made considerable headway northward into the Kennedy workings it was decided to stop pumping and to allow both mines to drown. That was in March, 1920, since which time they remained under water until April, 1921, when they were unwatered and reopened. Some of the upper workings of the two mines connect or used to do so, but the deep levels do not.

So much for the setting. Shortly before midnight of Sunday, Aug. 27, the timbering of the main shaft of the Argonaut was found to be afire near the point marked *F* on the diagram. Communication with those below by means of telephone and electric-bell line is supposed to have been broken by the fire soon after it started, so no signal was given to the miners working at the bottom, chiefly between the 4,800-ft. and the 4,650-ft. level. At first it was thought that the fire could be extinguished before the men would be in serious peril, and by the time their plight was appreciated it was too late. But this was not known until the end.

On Monday and Tuesday efforts were made to extinguish the fire by the use of water from above, but this proved futile. On Thursday it was decided to prevent it from spreading upward by building a bulkhead across the shaft at the 2,400-ft. level, for by that time it had reached nearly to the 2,500-ft. level. Owing to the fact that the Muldoon shaft was charged with smoke and fumes carried from the fire down the main shaft and thence through the mine, none of the imprisoned men were able to escape by that route, and nothing was known concerning their fate.

Controversy has arisen as to whether the ventilating

fan should not have been stopped at once, thereby permitting the heated air rising in the main shaft to reverse the direction of the ventilation. This would have drawn fresh air through the Muldoon shaft which would have remained fresh while it circulated through the workings and up to the level of the fire in the main shaft. It is contended that any opposing momentum left from the artificial ventilation after the fan had been stopped could have been checked promptly by closing temporarily the top of the Muldoon shaft. It would not have been necessary to reverse the fan. It is said that if this had been done the men might have climbed out of the mine through the raises and the Muldoon shaft, even though this involved a climb from the 4,800-ft. level and could probably have been acomplished by an athletic man in not less than five hours. At least, it is said, they could have reached the bottom of the Muldoon at the 3,900-ft. level and there awaited help.

As against this, however, some experts contend that it was right not to stop the fan. They insist that it is a first principle at the time of such a disaster not to reverse the ventilation, because any such change is confusing to the imprisoned men, who plan for safety on the assurance that the ventilation will remain as they know it. Others argue that the ventilating doors on the upper levels were not entirely effective, that some leaked or were open, and that therefore there was a short-circuiting of the air current so that the smoke and gas were not led immediately to the bottom workings, even with the fan in operation. This, however, is denied; and the argument is offered that even if it were true, the effect would be simply to deaden the air of the lower workings and to send the smoke from the main shaft into the Muldoon connections above the 3,900-ft. level, thereby again preventing escape through the Muldoon shaft.

On the night of Monday, Aug. 28, it was decided to attempt a rescue by establishing communication through the Kennedy mine. Early Tuesday morning the work was started. The fire of 1919 had burned the timbers in those workings nearest to the Argonaut and the admission of water in 1920 caused the ground to cave, filling the levels with mud and broken rock. An effort was made to reach the imprisoned men along two lines of approach; one on the 3,600-ft. level and the other on the 3,900-ft. level of the Kennedy. The lower of these was clear for the greater distance, but to connect it with the Argonaut workings required its being advanced 140 ft. through virgin rock. Altogether 475 ft. of rock and waste would have to be penetrated. By the 3,600-ft. level the total distance would be 530 ft. but the conditions appeared to be more favorable than on the 3,900. The 3,600-ft. drift would have to be extended in two places through virgin ground for a total distance of 130 ft. and would enter the Argonaut at a point 60 ft. below the 4,200-ft. level of that mine. Thus the task consisted partly of digging new drifts through debris and partly of blasting a way through rock.

It was thought that some of the men would have taken refuge at the north end of the 4,200-ft. level, because that drift is behind the shaft and nearest to the Kennedy workings, from which it was believed there was a leakage of air. The place would, therefore, be outside the line of the draft that was carrying the smoke and gases from the shaft into the workings below and to the southward. Others thought that the men would have made an attempt to escape through the Muldoon shaft and that they would be at the south end of the mine. In order to hasten the rescue it was arranged to work in 6-hr. shifts with gangs of 20 men at each heading, two men working at the face for 20 min. before being relieved by another pair. With good luck, an advance of 40 ft. could be made along a choked drift, and 16 ft. could be driven in live rock in 24 hr. Despite the litigation between the two companies their staffs co-operated loyally.

Connection was eventually made at 4:55 a.m., Sept. 18, between the 3,600-ft. level of the Kennedy mine and the 4,200-ft. level of the Argonaut, after slightly more than 21 days of work. On the 3,900-ft. level, 86 ft. of rock remained to be penetrated. When the men were reached it was found that they had taken refuge in a drift on the 4,350-ft. level, where they had made a vain stand against the fumes. A note, burned by acetylene flame on the mine timbers, indicated that they had perished within four or five hours after midnight on Aug. 27, after having built two bulkheads, using their clothes to make them tight. They had started a third when the gas evidently overcame them.

The coroner's jury has advised that "more precautions be taken to prevent fires" and that the two mines "be compelled to keep and maintain an opening with proper doors at one of the lower levels." The governor of California has appointed an investigating committee consisting of A. B. C. Dohrmann, president of the State Industrial Welfare Commission, William J. Loring, mining engineer and president of the American Mining Congress, and John C. Williams, miner and vice-president of the Grass Valley Miners Union.

To Eliminate Grade Crossings Under Federal-Aid Road Act

Washington Correspondence

As a result of the grade-crossing provision of the Federal Highway Act a great increase in the number of grade-crossing eliminations will take place from this time forward. In considering which crossings are to be improved, Thomas H. MacDonald, chief, U. S. Bureau of Roads, points out that consideration must be given to the following points:

Character of railroad (main line or branch); number of tracks; number of trains per day; approximate speed of trains at crossing; sight distance from each direction of approach; angle of crossing; method of financing (is railroad compelled by law to pay a part of the cost of elimination?); physical conditions as they favor elimination of crossing by under-pass, over-pass or relocation.

Intersections have been classified as follows: Class 1, grade crossings possible to eliminate by relocation; Class 2, crossing of a primary highway and a trunk-line railroad having two or more main tracks; Class 3, grade crossings of a single track trunk-line railroad and a primary road, or of any trunk-line and a secondary highway of the 7-per cent federal and road system; Class 4, grade crossing of spur and switch-lines, logging roads or branch lines on which train service is limited.

Original Investment as a Basis of Value in Rate Making

Effect of Changing Price Level on "Present Fair Value" — Regulation that Will Keep Investors Interested and Insure Supply of Required Capital

By Edward Flad
Formerly Member Public Service Commission of Missouri, St. Louis, Mo.

THE Missouri Public Service Commission, ever since it was established by statute in 1913, has been composed of four lawyers and one engineer. From April, 1917, to October, 1921, I was a member of the commission. Being an engineer by education and experience, with only a layman's knowledge of the law, I approached the problems that came before the commission from a viewpoint somewhat different from that of the lawyer members. In reaching a decision upon any question at issue, a lawyer, when acting in a judicial position and unhampered by the interests of a client, by force of training, will be guided by precedent. He holds that when the court shall have spoken, the law must be considered enrolled. His first quest is to determine what the courts have held in other similar cases, and having interpreted the previous decisions of the courts, he follows his interpretation ruthlessly and decides the question at issue with but little regard to what might appear to him to be fair and reasonable or for the general public good, were he not bound by his interpretation of court decisions. On the other hand, not being versed in the law and being untrammeled by knowledge of court decisions, my first endeavor was to determine what appeared to be fair under all the evidence and circumstances in each case, with due regard for the golden rule and the general welfare of the community; and having reached a conclusion, my next problem was to find competent authority for an interpretation of court decisions, even if a trifle strained, that would permit of the desired solution. And I may state in passing that, as a general rule, it was possible to find good legal support for the interpretation required.

Interpreting Law to Meet Modern Needs—The decisions of our courts bearing upon the right of the state to regulate and tax and even interfere with what we formerly conceived to be the inalienable rights of the individual, fully demonstrate that constitutional requirements, statutes and court decisions, may generally be interpreted to meet the changing and increasingly complex conditions and requirements of the community.

I was the more encouraged in my plan of procedure as above outlined by the early discovery that the four lawyers of the commission frequently disagreed among themselves in the interpretation of court decisions, as applied to particular cases under consideration. In at least one important case, two of the lawyer members held that the commission had jurisdiction and the other two held to the contrary, each side ably supporting its views by reference to court decisions. As it devolved upon me to cast the deciding vote, I felt at liberty to accept the interpretation that to me appeared best to protect the general public interest. The commission assumed jurisdiction by a vote of three to two and was upheld in that course by the Supreme Court of the State of Missouri.

And thus I find justification for approaching the question of rate base, or the value of a particular utility for rate making purposes, by first endeavoring to determine the solution that will best serve the ultimate interest of the general public and then adopting same if previous decisions of the courts can be construed to so permit.

Rate Regulation—The right to regulate utilities and fix the maximum rates is based upon the police power of the state, which may not be abridged, if it be not exercised in an arbitrary or oppressive manner. Under regulation, the state decides upon the nature of the service to be rendered, the net return that the owner may properly be allowed on his investment, the amount of bonds and stocks that he may issue and the manner in which he shall keep his accounts. It is akin to condemning the owner's property for public use, except that under regulation, he must continue to operate, to furnish funds for extension and betterments and to assume numerous responsibilities and hazards of loss.

The fifth and fourteenth amendments to the Constitution of the United States, sometimes referred to as the "just compensation" and "due process" amendments, will protect the owner against confiscation; but though the regulation fall short of confiscation, it may still be drastic enough to react against the general public good.

In order to accomplish its purpose, which is to secure continued and adequate service at the lowest rate possible, regulation must be such as will satisfy the average investor in public utility securities, for the relation between the investor and the public is a continuing one; extensions and betterments must be provided and new utilities established and unless the investor is satisfied with the regulation provided by the state he will refuse to invest and the utilities will fail to function properly.

The Investor's Viewpoint—Before laying down a general policy for determining the rate base we may therefore properly ask, "What will the investor in utility securities demand?" He will demand that so long as the funds that he provides are used in the service of the public, they shall be accorded a return that appears fair at the time he invests, with due regard to the risk involved. If it is generally understood that the regulatory body will normally protect the honest prudent investment, the investor will be satisfied. Under former competitive conditions, the investor assumed risks of loss even though the utility displayed all reasonable care and prudence in the management of its affairs, and the assumption of these risks justified an expectancy of abnormal gains. Under proper regulation however, competition is eliminated except where gross negligence or imprudent acts justify its invocation, and under normal conditions, the investment is protected.

Some will argue that the courts have held that the "present fair value" is the proper value to assume for rate-making purposes, that the reproduction cost new

as of the date of inquiry, should be the controlling factor in determining present fair value and that "original cost" is no measure of the "present fair value."

We may agree that "present fair value" must be the controlling factor, and still differ as to the definition of "present fair value" or the manner in which it shall be determined. Value in exchange depends upon net earnings, which, in turn, depend upon the rates allowed; and the rates are to be determined by the value, and so we circle around, lost in a labyrinth of definitions and interpretations of court decisions.

Valuation at Reproduction Cost—How would a valuation of the basis of reproduction cost as of the date of the investigation affect the security holder? Let us assume a utility organized with an investment of $100,000, sufficient to provide the plant and property, stores and supplies and working capital. One hundred thousand dollars is placed in the service of the public and the individuals furnishing the funds receive in lieu thereof, $50,000 in bonds, $30,000 in preferred and $20,000 in common stock. The rate of return for each class of securities must bear a proper relation to the risk involved. Five per cent for the bonds, 7 per cent for the preferred stock and 10 per cent for the common stock would probably be considered sufficient under normal conditions, such as existed prior to the recent world war. The total annual interest and dividend charges for our $100,000 corporation, would therefore be $6,600 or 6.6 per cent on the investment. During the recent period of inflation many of the utilities have demanded a valuation as of the date of the investigation. In a number of instances which came before the Missouri commission such a valuation, if granted, would have been double the actual investment. With our $100,000 utility as above assumed, if constructed before the war, the fixing of a rate base during recent peak prices would have resulted in a valution of $200,000. If a 7 per cent return were allowed, there would have been $14,000 per annum available for interest and dividend charges. The holders of the bonds and preferred stock would have continued to receive 5 per cent and 7 per cent respectively, receiving no direct benefit from the inflated valuation, but the holders of the common stock would have earned annually 47 per cent on their investment.

The application of the same formula, during normal times, to a utility whose investment had been made during a period of inflation, would reduce the earnings below what would be necessary for proper functioning, and inevitably result either in receivership or cessation of service.

Though each may appear fair in the light of all of the facts in that particular case, it seems entirely unnecessary and unreasonable to accept an interpretation of court decisions that will lead to the adoption of a policy for valuation of our utilities calculated to give a temporary advantage to the holders of the equity, but manifestly unfair and entirely contrary to the ultimate interest of both the investor in utility securities and the consuming public.

Valuation on Investment Basis—By establishing a rate base on the investment theory the investor is reasonably sure of a return which, at the time he invests, seems fair to him, considering the risk involved, i.e., whether he purchased bonds, preferred or common stock. Under such procedure it would be incumbent upon the commission to take into account, in fixing the rate of return, either increases or decreases in prevailing interest rates at any time, in so far as they affected refunding propositions, or the sale of additional securities required to finance additions and betterments.

I maintain that the average investor in utility securities will be satisfied with a valuation on the basis of original investment, independent of accrued value due to inflation of the currency or growth of the community, provided he is insured, as far as may be, against loss due to a deflation of the currency or ruinous competition and has reasonable assurance that his honest, prudent investment will be protected. More than this is not necessary because it is not required by the purchasers of securities and would, therefore, place an unnecessary burden upon the consumer, and less than this will fail to secure the funds required for construction, additions and betterments.

The majority of our present utilities were organized before the days of regulation. Our larger utilities represent combinations of many smaller corporations and in most cases past accounting methods will not furnish correct information as to actual investment in the plant used and useful at the time of the investigation. Where the actual investment may not be ascertained, an estimate of the cost of construction, as of the date of construction is more illuminating, can be made with greater accuracy, and properly has more bearing upon the question of "rate ease" than an estimate of the cost of construction as of the date of the investigation. It is, of course, conceded that all relevant evidence, such as the degree of prudence exercised in the investment, the depreciated condition of the plant, early losses, excessive past earnings, cost of consolidation, extraordinary efficiency in operation or construction, etc., must be given proper consideration in a final determination of the rate base.

Supporting Legal Authority—Having reached the conclusion that the rate base should represent the honest, prudent investment, with such qualifications as may be indicated by all relevant facts, because that policy will satisfy the average investor, encourage the investment in utility securities, allow utilities to function properly, secure the lowest possible rates for service and do justice to both the utilities and the consuming public, I am pleased to note that competent legal authority can be found to construe the decisions of our courts so as to permit of its legal adoption.

It would be pretentious for me, a layman in legal matters, to construe the decisions of our courts. For the benefit of those who may desire to delve into individual controversies, and generalize from the decisions reached, I submit herewith references to various cases which have been cited, some for and others against the adoption of the policy herein advocated. The oft-quoted case of Smythe vs. Ames (169 U. S., 466-1898) has been cited as justifying a valuation based upon "investment" as well as one based upon "reproduction cost new."

Other cases cited are as follows: For a value based on "Investment"; (1) Ames vs. Union Pacific Ry. Co., 64 Fed. 165, decided Nov. 12, 1894, Justice Brewer; (2) Brymer vs. Butler Water Co., 179 Pa. 231, 36 Atl. 249, decided Jan. 4, 1897; (3) Coal & Coke Ry. Co. vs. Conley, 67 W. Va. 129, 67 S.E. 613, decided March 8, 1910, Supreme Court of Appeals of West Virginia; (4) City of Appleton vs. Appleton Water Co., 5 W. R.

C. R., 215, decided May 14, 1910, Wisconsin Railroad Commission; (5) Mahew vs. Kings County Light Co., 2 P. S. C., 1st D. N. Y., decided Oct. 20, 1911, New York Public Service Commission for First District; (6) Petition of Grafton County Electric Light and Power Co., 28 A. T. & T. Co. Com. L. 533, Feb. 3, 1914, New Hampshire Public Service Commission.

For a value based on "Reproduction Cost as of the Date of Investigation": (1) Case of St. Joseph Ry., Light, Heat & Power Co., Van Valkenburg, J., District Court of the U. S. (268 Feb. 278), decided Nov. 10, 1920; (2) P. U. C. of Ill. ex rel City of Springfield vs. The Springfield Gas & Electric Co., (Docket No. 13,048 Illinois Supreme Court); (3) San Diego Land & Town Co. vs. Jasper, (189 U. S., 439-1902); (4) Stanislaws vs. San Joaquin Co., (192 U. S., 201, 1904); (5) City of Knoxville vs. Knoxville Water Co., (219 U. S. 1-1909); (6) Wilcox vs. Consolidated Gas Co., (212 U. S. 19-1909); (7) Louisville & Nashville R.R. Co. vs. Railroad Commissioners, (196 Fed. p. 800); (8) Consolidated Gas Co. vs. Newton, U. S. Dist. Court, S. Dist. of N. Y., (267 Fed. 231-1920); (9) Denver vs. Denver Union Water Co., (1918 C. P. U. R. 640); (10) East Chicago vs. East Chicago and I. H. W. Co., Indiana Commission (P. U. R. 1920 p. 192); (11) San Diego Land & Town Co. vs. National City, 174 U.S. 739, 757.

Effect of a Low Dam at Harrisburg on Flood Stages and Discharge

By S. N. WHITMAN
Of Gannett, Seelye & Fleming, Inc., Engineers, Harrisburg, Pa.

DISCHARGE records, before and after construction, show that a 4½-ft. dam across the Susquehanna River at Harrisburg, Pa., has no effect on the discharge and corresponding gage height when the mean depth is 300 per cent of the dam height. The Harrisburg studies were made by the writer in connection with a report which he prepared on a similar improvement at Elmira, N. Y., on the Chemung River. At Elmira, however, the total amount of slackwater required can only be produced with a movable dam in order not to cause flood damage greater than that which would be experienced without the dam.

The Susquehanna River at Harrisburg is almost three fourths of a mile wide and is confined between banks averaging 25 ft. in height above low water. The channel is crossed by several bridges and is dotted with islands forming an irregular chain in mid-stream. At low river stages large areas of the channel were exposed where stagnant water was formed which subsequently became very foul smelling and bred many mosquitoes. The currents were swift and the channel shallow, making it almost impossible for canoeing or other recreations.

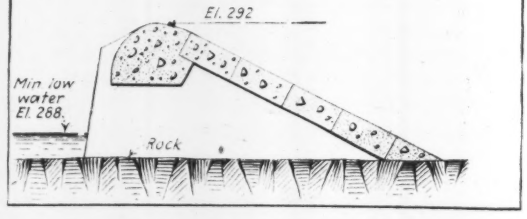
James H. Fuertes, consulting engineer, New York City, designed a low type of reinforced-concrete dam approximately 0.6 mile long and averaging 4½ ft. in height. It does not extend quite to the river banks at full height, small openings being provided so that the minimum discharge will just flow over the entire crest. Construction began in 1913 and was practically completed in one year except that several small openings were not closed until 1916. The dam provides slackwater which is now very popular for recreation purposes. With the additional improvements made to the river front and sewer system, the river front has been transformed into one of the most beautiful parts of the city.

The data here used for comparative purposes were kindly furnished by the Pennsylvania Water Supply Commission and the city engineer of Harrisburg, Pa.

The Weather Bureau gaging station records for the Susquehanna River discharge at Harrisburg are available since January, 1891. The construction of the sanitary dam was closely followed to note the backwater effects at the gage, which is located 4,200 ft. up stream. These records are invaluable in the study of the obstruction effects of the dam. The rating curve used until Dec. 31, 1913, was used for the pre-construction discharges and the one effective since Aug. 30, 1916, for the post-construction discharges.

The accompanying diagram shows the mean depth at the dam expressed in percentage of the dam height and

Gage height in feet	Discharge as per cent of preconstruction discharge	Mean depth as per cent of dam height
13	97	297
12	96	276
11	95	254
10	93	234
9	91	213
8	87	193
7	82	173
6	72	157
5	57	141



EFFECT OF DAM ON PRE-CONSTRUCTION DISCHARGE

the present discharge expressed as a percentage of the pre-construction discharge for the various Weather Bureau gage readings.

This curve shows that for a gage height of 13 ft. the obstruction effects are negligible. The variation listed is within 3 per cent of the pre-construction discharge and can therefore be considered as within the normal discharge variation limits of the mean rating curve.

The control at Harrisburg has not changed and when the flood stage has reached an elevation where all obstruction effects are lost it is probably true that the present rating curve gives more nearly correct values for all the higher stage records and that a comparison beyond this height becomes a mere mathematical expression.

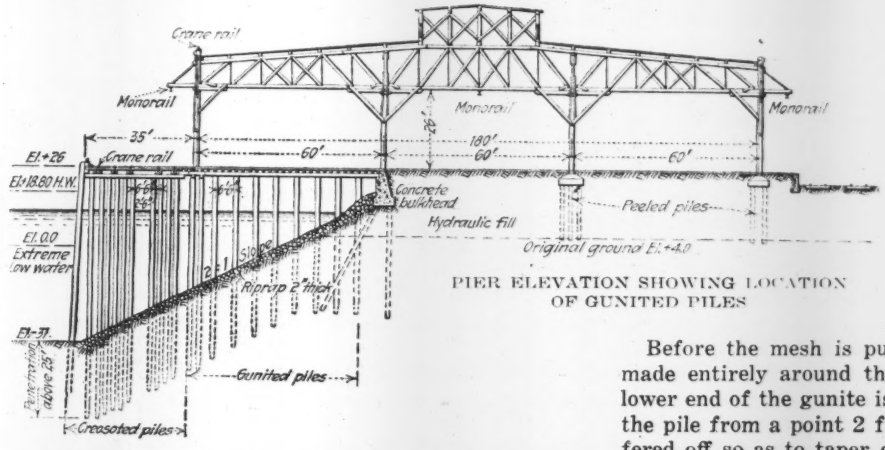
Very little information has been collected on the discharge of submerged weirs. The coefficients obtained to date are usually for discharges under exceedingly low heads and the velocities of approach and retreat have not been given due consideration. Each installation is affected by many local and construction conditions and the information here listed is valuable for comparative or checking purposes for improvements of a similar nature.

Gunite Applied to Fir Piles For Tacoma Pier

No Cracks If Two Applications Used—Piles Vertical When Coated, Delivered by Raft—Coating Costs $1.20 Per Foot

IN CONSTRUCTING a new pier for the Port of Tacoma, creosoted wooden piles were satisfactory for fender lines and under the open portions of the structure, but in order to avoid the probability of having to disturb the shed and goods stored therein, it was decided to use under the superstructure some form of support that would not require renewal in a few years. Accordingly decision was made to use fir piles coated with gunite. Adding the cost of treatment at $1.20 per linear foot to the original cost of the piles, the total cost was approximately twice as much as creosoted piles and about half the estimated cost of the ordinary reinforced-concrete piling.

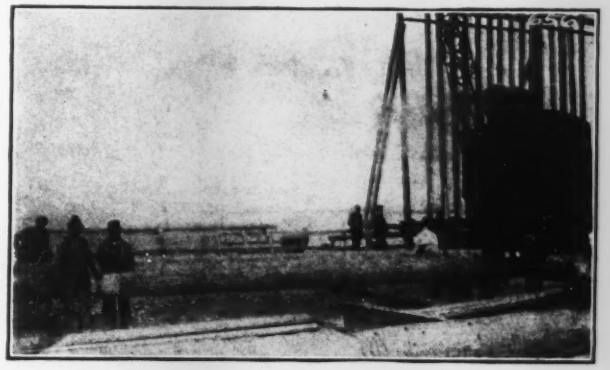
Foundations for that portion of the pier to be occupied by the superstructure called for 1,450 piles. The actual footage of piling to be gunited is 54,131 lin. ft. About 1,400 piles had been gunited by the tenth of September and about 800 had been jetted down in place, apparently with complete success. In getting the piles down only the weight of the hammer is ordinarily used and heavy blows are never struck.



PIER ELEVATION SHOWING LOCATION OF GUNITED PILES

The piles, stripped of all bark, arrive at the site in rafts from which they are lifted by a locomotive crane and delivered to the yard where the mesh reinforcing is attached. From this point a locomotive crane conveys them, one at a time, to the shooting rack, about 1,100 ft. long, erected along the edge of a fill near the new dock. This fill is retained by a bulkhead along the water's edge consisting of two rows of piles and planking projecting 10 to 12 ft. above low water level. The rack consists chiefly of a third row of piles, spaced about 25 ft. apart fastened at the bottom to the piles that retain the fill and extending 40 to 50 ft. above the level of the fill. Stringers or tie-timbers run along the tops of the piles in the rack and serve as supports for the upper end of the piles to be coated.

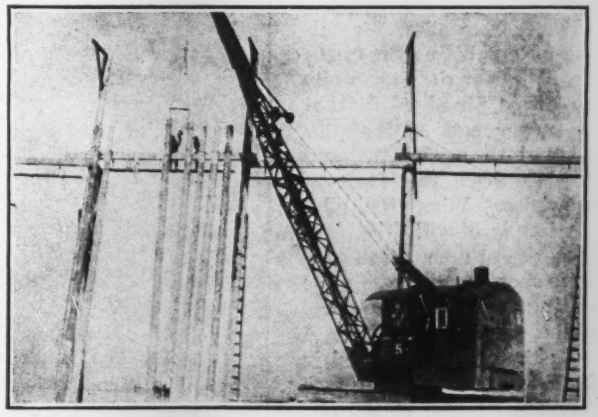
Another run of timbers at water level serves as a base or support on which the bottoms of the piles to be coated may rest. The rack thus provided will accommodate 542 piles at a time and is divided into bays, 18 to 28 ft. long, according to the distance between the supporting piles. Some of the bays have the stringer at the top higher than others, thus providing for various lengths of piles to be coated. The rack is paralleled for its full length by a track on which the locomotive crane operates.



FASTENING MESH REINFORCING ON THE PILES

The reinforcing consists of electrically welded wire mesh, 2 in. square, made of No. 12 galvanized wire. This comes in 5-ft. widths and for each pile a length is cut from the roll equal to the length of that portion of the pile to be coated. Specifications require the reinforcing to have a minimum lap of 4 in. when fastened to the pile. Metal chairs, or spacers, are used to hold the mesh in place at the desired distance of ¾ in. from the surface of the pile. The spacers are put on in rings 2 ft. apart, eight to the ring, and fastened to the pile with 16-penny wire nails.

Before the mesh is put on, a saw cut 2 in. deep, is made entirely around the pile at the point where the lower end of the gunite is to terminate. The surface of the pile from a point 2 ft. above this cut is then chamfered off so as to taper down to the bottom of the cut. This avoids a ridge where the gunite begins and also forms a constricted section protected by a shoulder in a way calculated to resist any tendency of the concrete



PILES DELIVERED TO PLACE BY LOCOMOTIVE CRANE
Each pile is held near the top by a single turn of rope.

APPLYING GUNITE TO SEVERAL PILES SIMULTANEOUSLY

shell to slip up the pile as it is being jetted into place. In addition to the metal spacers, four to six wraps of ¼-in. wire are nailed on over the mesh in this tapered section to aid in holding it in place and making a firm bond between pile and gunite. While the pile is laid out horizontally a tapered iron tip is fastened to the lower end to aid in turning the pile while it is being coated in the rack.

Instead of guniting the entire length of the piles and then driving them small end down as usual, gunite was omitted on the butt ends and the piles were driven butt down. By this plan the perimeter and bearing value of the portion below mud line was equal to that that would have been obtained with the gunited smaller ends and at the same time the cost of guniting the lower ends of the piles is saved. Because the lower ends are buried gunite there was unnecessary, in the opinion of those in charge, as a protection against borers. Thus the net result of driving the piles butt down was the saving of about 25,000 lin. ft. of guniting. Penetration below the mud line averages about 25 ft. and hence the gunited portion of the pile extends about 10 ft. below mud line. The piles used vary from 46 to 68 ft. in length. They range from 14 to 18 in. in diameter at the butt with a minimum of 10 in. at the top.

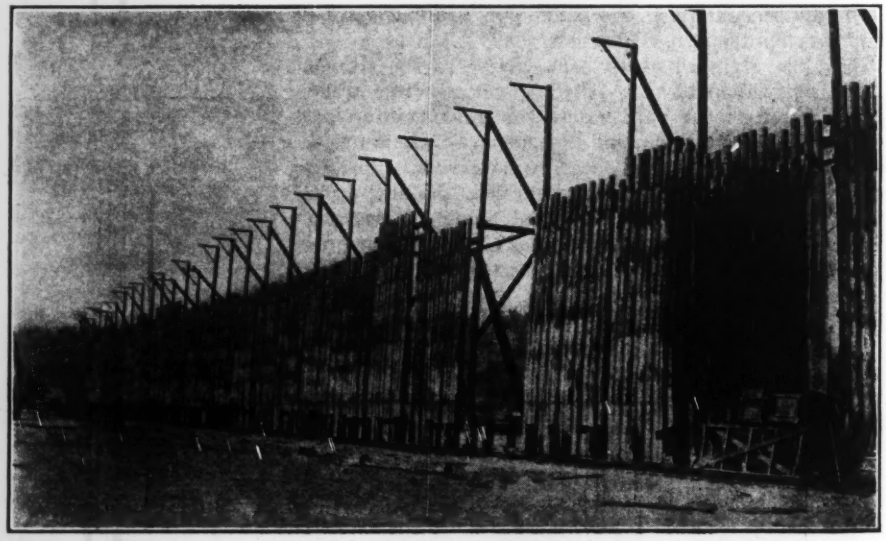
In order to allow for cutting off and fitting the top of the pile under the cap, gunite is omitted for about 5 ft. at the upper end of the pile, although the mesh is fastened in place here the same as elsewhere. When the piles are in place with the caps properly set upon them, gunite is shot on to complete the coating around the upper end of the pile.

As the piles are placed in the bays of the shooting rack they are secured at top and bottom by a rope, a single turn of which is thrown around each pile to hold it to the horizontal timber. Each gun crew consists of five men, two on the gun, one on the nozzle and one at top and one at the bottom of the bay in which work is in progress. The man at the bottom turns the piles with a peavy as the progress of the coating requires, thus making it possible for the nozzle to be worked from one side of the rack only. The man at the top releases or tightens the rope and maintains a clearance between the surfaces of adjacent piles. The ten to twelve piles in each bay are coated simultaneously, the nozzle man beginning at the top and working downward. The nozzle is operated from a scaffold slung from brackets at the top of the rack and the scaffold is lowered as the work advances. Each of the two five-men crews can gunite about 300 lin.ft. of piling per eight-hour shift.

Materials ready mixed for the gun, except for the addition of water, are delivered by the locomotive crane in 1¼ cu.yd. boxes. These boxes are set on portable benches that hold three boxes each and have just the right height and deck inclination so that when a trap door in the lower end of the box is opened the materials readily flow into the charging hopper of the guns. Guns, benches and boxes are moved along the rack from bay to bay by the locomotive crane, so the gunite delivery hose does not exceed 80 ft. in length. Water and air pipes run along the rack for its entire length with taps at convenient intervals. The gun is operated with air pressure of about 50 lb. per sq.in., this serving for efficient delivery to a height of 60 ft. which is the maximum height of the nozzle above the gun level.

At first the full gunite covering, 1½ to 2 in. thick, was applied in one operation; this resulted in extensive hair cracking or checking of the gunite. Experiments with various means of preventing this were unavailing and the conclusion reached by those in charge was that jetting wet cement against the wood under pressure forced moisture into the wood fibre of the pile and caused swelling. The cracking was so extensive that in order to adequately protect them it was necessary to put on a tar coating over the gunite on all piles on which the full thickness had been put on in a single application.

A means found to prevent almost entirely this checking was to put on the gunite in two applications. The



RACKS SUPPORTING PILES IN PROCESS OF CURING

first application is made to just cover the reinforcing and is allowed to stand for 48 hours. The second application then follows, increasing the thickness to 1½ or 2 in. Only a very few widely scattered cracks appear in gunite applied in this way and this is in only a small percentage of the piles. From several tests made by breaking out the gunite after it had thoroughly set, it was found that where small hair cracks appeared in the second coat they extended through this coat only. Cracks which appeared in the first coat did not carry through the second coat, nor did cracks occur over or in line with one another.

The gunite, when in place, is required by the specification to be a mixture of one part cement and two and one-half parts sand. Requirements for the sand are that not less than 50 per cent shall pass a No. 20 mesh screen and 100 per cent shall pass a No. 10 mesh screen. The thickness of the gunite is required to be not less than 1½ in. and not more than 2 in. at any point.

During the process of curing the gunite is kept wet by water from pipes run along the top of the scaffold and perforated so small streams play on the upper ends of the piles. Experiments showed that this could be applied without washing out the cement about four hours after the gunite had been shot. The same allowance for initial set before turning on the water is made for both first and second applications. The water pipes are in sections, one section for each bay served by a hose from the water main along the fill, thus sprinkling water in each bay can be controlled independently. The sprays run all day for ten days after shooting. Burlap in large sheets is hung on the sunny side of the piles during hot weather to aid in retaining the moisture sprinkled on at the top.

The piles are allowed to stand in the rack twenty days and are then taken by the locomotive crane to a raft with which they are towed to the pier. The raft consists chiefly of a rack in which about 10 ft. of the upper end of the piles can be fastened, thus preventing them from bumping and scraping, as they are being towed. The water is deep where the piles are delivered to the raft and because of their buoyancy in water it is not believed that this method of handling causes much cross bending in the pile.

The work is under the direction of G. W. Osgood, chief engineer, Port of Tacoma.

American Type of Guyed Derrick in England

High-building construction work in England has been done largely by the aid of stiff-leg derricks mounted on tall timber towers, which towers obstruct the work to some extent. The *Iron and Coal Trades Review*, London, illustrates a "revolution in derrick crane design" which is simply the introduction of the familiar American guyed derrick with steel box-lattice mast and boom. This type of derrick raises itself from floor to floor by its own power as the work proceeds, thus dispensing with any falsework supports. The British "derrick crane" described has an 86-ft. mast and 80-ft. boom, with a hoisting capacity of 7 tons at 80 ft. radius. Seven ¾-in. cables or guys are attached to a spider on the head of the mast. This derrick was designed and built by Caswell & Shearing, London, and is in use by John Mowlem & Co., contractors for the new Belgian Bank in London.

Combined Irrigation and Drainage Plant in Louisiana

One Oil-Engine Pump Delivers or Removes Water as Needed on Rice Plantation—Two Ditch Systems with Control Gates

By Arthur M. Shaw
Consulting Engineer, New Orleans, La.

In the economic development of the rice-growing industry in southwestern Louisiana it is necessary to provide for variation of crops and this involves both irrigation and drainage of the same tract of land. On the project described in this article a single pumping plant has been arranged to serve both these opposite

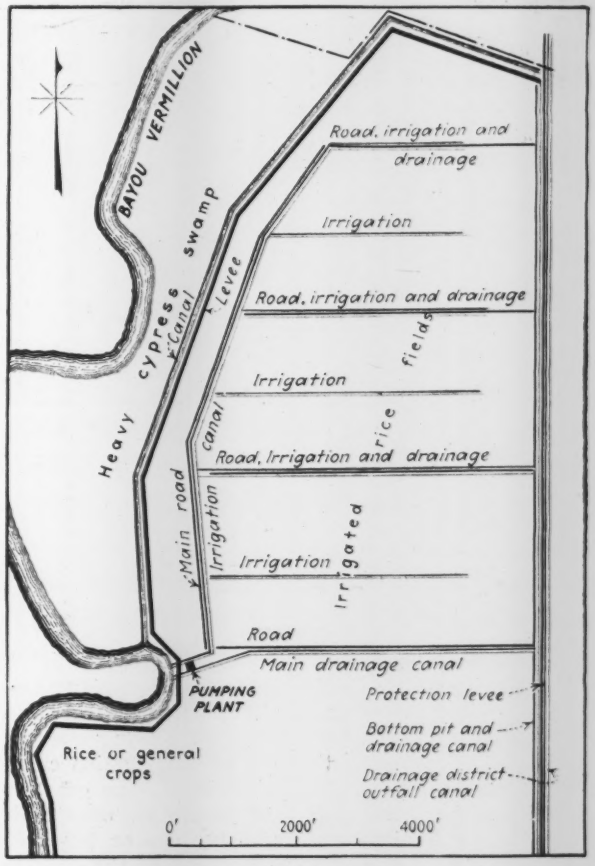


FIG. 1. PLANTATION WITH BOTH DRAINAGE AND IRRIGATION

purposes, thus effecting material economy and efficiency in the supply and use of water and in crop production.

Most of the irrigation water used in the rice growing sections of Louisiana is taken from small bayous, although a considerable amount is taken directly from the Mississippi River and there is some pumping from shallow wells. Plants which pump from the bayous are owned sometimes by private interests and sometimes by canal companies which serve a number of plantations. The amount of water required will vary with the season and is affected materially by the character of soil and methods of application of the water. Under average conditions and with a compact or "tight" soil, it is considered that a pumping capacity of 7 gal. per minute

per acre will suffice; 10 gal. would be the maximum capacity desired and 5 gal. the minimum safe limit.

For the rehabilitation of the Live Oak plantation owned by the Vermilion Farms Co., of Abbeville, La., the writer was engaged as designing and consulting engineer. An area of about 3,600 acres was selected for the first unit, shown in Fig. 1. This is an economical size from an engineering and an operating point of view and it permits the use of all suitable lands owned by the company within certain boundaries. These boundaries are property lines on the north, an outfall canal (serving higher land drainage) on the east, the right-of-way of the proposed Intercoastal Canal on the south, and the bayou Vermilion and a tract of heavy cypress swamp on the west.

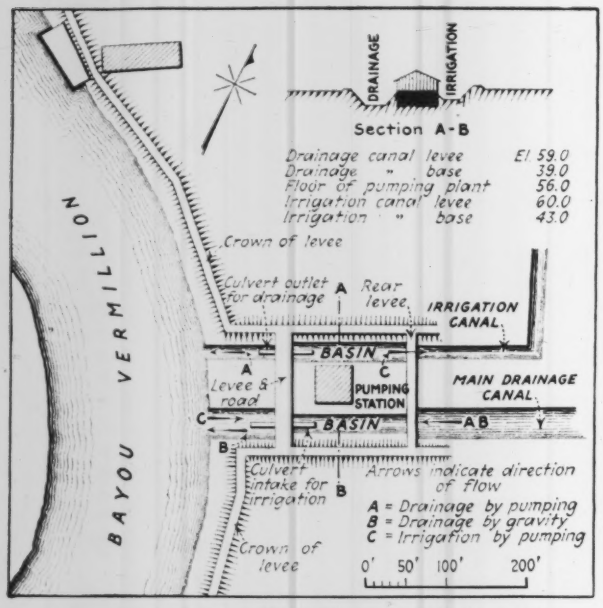


FIG. 2. PUMPING STATION SERVES TWO SETS OF DITCHES

Topography and Soil—Parallel with and usually adjacent to the bayou is the silt-built ridge or natural levee which is common to most of the silt-bearing streams of the Gulf Coast country. The main irrigation canal follows practically the top of the ridge. The greatest elevation above mean gulf level is slightly over 7 ft. while the flat prairie lands are only one or two feet above sea level. Probably 66 per cent of the area is below Elev. 3, or 53 as shown on the drawing, the datum plane for which is 50 ft. below mean gulf level. The ridge is composed of a sandy clay soil, easily cultivated but of sufficiently close texture to facilitate canal construction and to prevent excessive waste of water in irrigation.

Development Works—The varying soil conditions, frequent disasters of "one crop" projects and the economic necessity of rotation of crops were controlling factors in the decision reached by the owners to develop the project for general farming and stock raising, instead of as a rice plantation only. This made necessary the following engineering works: (1) A levee system for protection from storm tides; (2) a system of interior canals for drainage; (3) a separate system of canals and ditches for irrigation; (4) "rice levees" for areas to be used for rice growing; (5) pumping facilities for drainage; (6) pumping facilities for irrigation; (7) a system of interior roads; (8) a wharf for handling water borne freight.

Levees and Canals—As a protection against flooding by severe Gulf storms which formerly had put all but the highest points under water, the tract was enclosed by a levee having a uniform height of 7 ft. above Gulf level, side slopes of 1 on 2 and a top width of 6 ft. At one point where very soft material was encountered, the levee was built up in layers and with slopes of 1 on 3.

Interior drainage canals were constructed as shown in Fig. 1. The main drainage canal, leading to the pumping plant, is 70 ft. wide and has a maximum depth of 14 ft. Other canals are 40 ft. wide with an average depth of seven or eight feet. Additional interior canals or large ditches may be required as the tract is developed. Intermediate drainage ditches are constructed as the particular type of improvement of the section may require. In general, fields used for corn, cane and similarly cultivated crops should be provided with small ditches spaced at intervals of 160 ft. while pasture and meadow lands may be served satisfactorily by ditches at twice or three times that spacing. The spacing depends largely on the surface slope and the texture of the soil. A complete system of irrigation canals for serving the rice lands was outlined, but only the main canal and laterals necessary for the first section were constructed. The trunk canal is designed to carry the normal flow from the pumping plant which is about 52,000 g.p.m.

In rice irrigation it has been usual to construct field levees at each 4-in. drop in elevation; these levees following the 4-in. contours. On the Live Oak project, this interval was reduced to 3 in., with the idea that greater uniformity of flooding could be secured and there would be less danger of the breaking of small levees while water was being applied. These smaller levees offer little obstruction to ordinary farming machinery and are easier to maintain. Since they require less special labor they cost no more than the others, even though more are required for a given area.

Pumping Plant Serves Two Purposes—As pumping for both irrigation and drainage was required, it was decided that the same facilities should serve both purposes. The plant is near the other headquarter improvements along the bayou bank, thus securing convenience of supervision, economy in handling fuel and supplies and available help in case of emergency. Flexibility of operation is secured by a system of culverts, each equipped with a pair of flood gates which can be operated mechanically or permitted to act automatically. No effort was made to secure extreme sensitiveness in automatic action, as the gates are under constant supervision and normally will be controlled by mechanical means. The location of the culverts is shown in Fig. 2 and the gate construction in Fig. 3. If the plant had not been planned for future extension it would have been better to reduce the length of the suction and discharge basins by placing the dams and culverts east of the station as close to the building as practicable.

By suitable adjustment of the gates, any one of the following operations may be carried out: (1) Pump from the bayou into the irrigation canals; (2) pump from the drainage canals into the bayou; (3) pump from the drainage system into the irrigation canals;

(4) drain by gravity from drainage system into the bayou; (5) drain by gravity from the bayou into the drainage system. These last two operations can be carried out only at times of suitable stages of water in the bayou and the canals.

The first two are the "normal" operations for irrigation and drainage respectively, though substantial benefits have been derived from each of the others. It frequently happens that drainage of the pasture lands and of the cultivated crops is required at the same time that water is to be applied to the rice crop. In this way, practically all the drainage that is done during the irrigating season is secured by operation No. 3. During the winter months, when no pumping is required except for drainage, the tide in the bayou is frequently

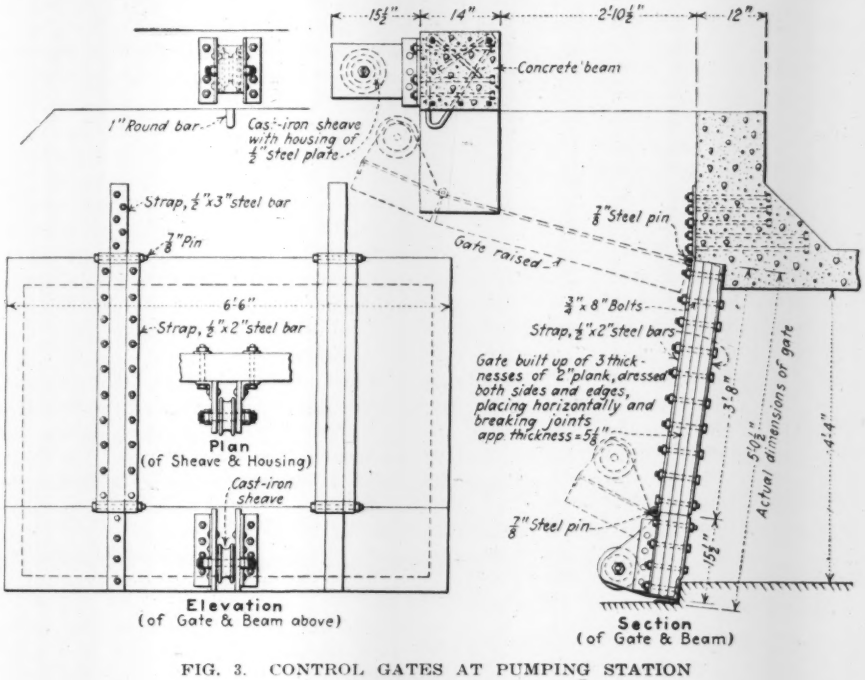


FIG. 3. CONTROL GATES AT PUMPING STATION

considerably below mean gulf level and the drainage canals may be emptied by gravity. During the past year, demands for drainage alone required the operation of the pumping plant for only twelve days, all other drainage being secured as an incident to irrigation (operation No. 3) or by gravity discharge into the bayou (operation No. 4).

Salt water is blown occasionally up the bayou, making the water unfit for irrigation. This condition existed for a period of several days last year, but the manager foresaw the trouble and filled the drainage canals to the highest permissible stage, thus storing sufficient good water to care for the rice crop. This fifth operation was not contemplated originally but was suggested by the manager and included in the final plans.

Pumping Plant—This plant includes a 48-in. double-suction centrifugal drainage pump, a 180-hp. semi-Diesel oil engine and a 6-hp. engine operating on kerosene for driving auxiliary equipment. There is also a vacuum pump, air compressor, air receiver and miscellaneous shop tools.

Suction and discharge pipes were constructed of ¼-in. plate. Following the writer's usual custom, sketch drawings only were furnished to bidders for the construction of these pipes as it has been found that most boiler shops prefer to make their own shop drawings for such work, but it was required that the drawings be submitted for approval before plates were cut. The sketch was also accompanied with specifications as follows:

"Tapering increasers shall be used for connecting suction and discharge pipes to pump, tapering gradually to a diameter about 10 per cent greater than that of the connecting pump flange. At the end opposite from the pump, pipes shall bell out to an end area equal to four times that of the connecting pump flange, this increase in area being secured by means of a gradual taper of not greater than one foot of increase in diameter to each four feet in length. No sharp bends will be permitted."

Advantages of a Two-Unit Plant—While the machinery has made a good showing in economy of operation and in dependability, a two-unit plant would give greater insurance against interruption of service and would provide greater flexibility in operation. With only 1,000 acres under irrigation, it is not practicable to use the water as fast as it is pumped by the one 48-in. pump, so that a considerable amount of the pumped water is wasted by bypassing to the bayou. Two 36-in. pumps would give slightly greater capacity and would permit the use of duplicate units. In this size also it would be possible to secure pumps suitable for direct connection to internal combustion engines. The cost, however, would be somewhat greater than that of the single unit of approximately equal capacity.

Assuming the capacity of the present unit as ample for the project and that irrigation will never be required for more than half the area enclosed, it is probable that the following equipment would yield the greatest ultimate economy: (1) A 24-in. irrigation pump designed for the greatest attainable efficiency when pumping against the normal irrigation head; this pump to be direct-connected to an engine and operated as near constantly as practicable; (2) a 42-in. pump for emergencies. This latter pump should have a large capacity over a wide range of head but need not be designed for exceptional efficiency at any particular head. It would be belt-connected to an engine similar to that now in use. The smaller unit would be ample for all irrigation demands and would handle the run-off resulting from moderate storms, both pumps being used after heavy storms. With reasonable storage capacity in the drainage canals, it is probable that more than 75 per cent of the pumping would be done by the smaller and more efficient unit.

Construction Methods—Canal and levee construction was done by the Huth Dredging Co., Franklin, La.,

working under a yardage contract. Measurement of work was by completed excavation, though a special time clause was included in the contract to cover special work. Provision was made for multiple layers to be placed on levees under the yardage contract but it was stipulated that the contractor was not to be required to place more than three layers on any one section of levee under the yardage clause and should be paid for moving time under special conditions. For the fourth and succeeding layers, he could be paid on the yardage basis or hourly basis, as he might elect. His equipment consisted of two floating dredges of 1½ and 2½ yd. capacity respectively. Navigable water ways were available to reach the work.

Test borings showed that the sandy clay top soil at the site of the pumping plant merged into the tenacious clay of the rear lands at a depth of only a few feet and this was considered ample for foundations without the use of piles. At about 2 ft. below the excavation required for the deepest culvert, a sand stratum was encountered and interlocking sheet piling was used to prevent seepage and undermining. The piles were jetted down through the sand and then driven into the underlying clay to a depth of three or four feet. Excavation for the culverts was done mainly by the dredges, but in spite of extra care to cut to exact grade one place was carried about 3 ft. below proper grade and the excess excavation became filled with soft mud. To avoid the cost of taking out the mud and protecting the work by cofferdams, brick bats were dumped in and rammed down by heavy timbers until the mud was forced out and a solid foundation secured.

Construction was carried out under the direct supervision of E. P. Putnam, Jr., president and general manager of the Vermilion Farms Co., with E. J. Kevlin as resident engineer. The latter reported to the resident manager in all matters excepting those of a technical nature, which were reported directly to the writer. Most of the work except the dredging was done by plantation laborers, supplemented by special workmen as required. With the exception of a concrete mixer and a small home-made pile-driver, practically all the construction equipment was such as is found on any large, well equipped plantation.

Flume Takes Place of Culvert on Skagit Railroad

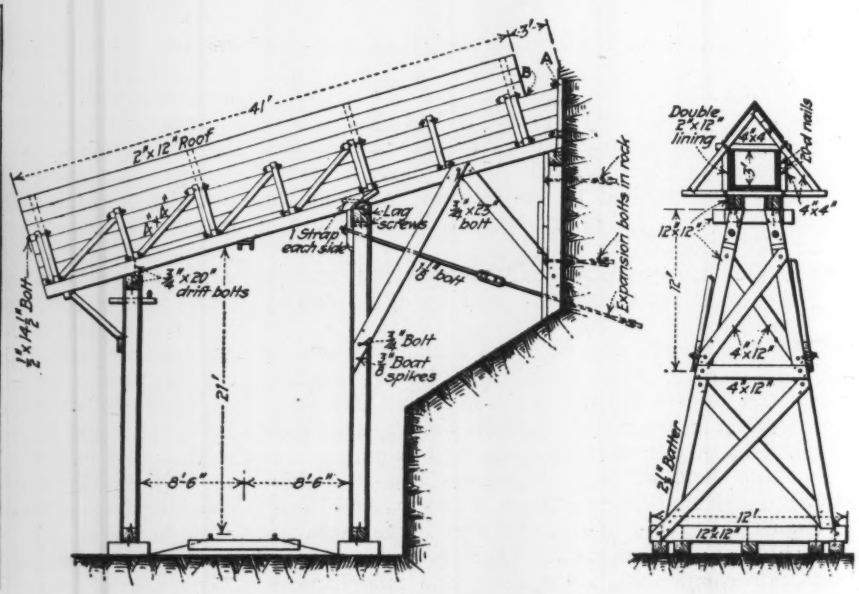
THE construction railroad serving the Skagit hydroelectric project, which is being carried out by the city of Seattle, Wash., operates an electrified extension through the Skagit Gorge. At one point on this line a small stream comes down a precipitous rocky slope above the track in a location such that the stream could not be economically diverted at some level above the track bed. As compared to the cost of providing a channel down the rocky wall and a culvert under the track, it was considered preferable to build a flume above the track, as shown in the accompanying illustration.

A 3 x 3-ft. flume is considered sufficient for carrying all the flow expected in periods of maximum runoff. To catch the entire flow the upper end of the flume is flared from a 3-ft. width at *"C"* to a width of 8 ft. at *"A."* At the upper end the flume timbers were cut to fit closely against the rock and wedges were driven to make the joint as tight as possible. Joints between planks in the sides and bottom of the flume were well caulked to prevent leakage.

The photograph shows a winter view of the overhead flume with ice forming where the water passes through the cold air. No difficulty with ice forming on the track has occurred because the steep slope of the flume gives the water sufficient velocity to carry it to the far side of any ice formation.

A general description of the Skagit project, of which C. F. Uhden is chief engineer, appeared in *Engineering News-Record*, Nov. 18, 1920, p. 994.

CULVERT FUNCTIONING IN WINTER



SECTION AND ELEVATION OF "OVERHEAD CULVERT" SKAGIT PROJECT

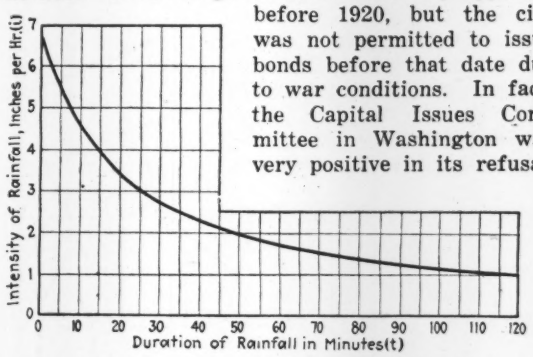
Detroit's Intensive Sewer Construction Program

Relief Sewers in Old Part of City and Trunk and Lateral Extensions Being Built—$31,570,000 of Bonds Authorized—Program and Methods Outlined

By J. R. Hendry
Engineer Sewer Design, City Engineer's Office, Detroit, Mich.

DETROIT is in the third year of an intensive sewer construction program. In 1920 and 1921 nearly 43 miles of main and about 158 miles of lateral sewers were built at a combined cost of over $19,000,000, while the estimated figures for 1922 are 50 miles of main and 90 miles of lateral sewers at a cost of $14,350,000. This large amount of work has aroused more than local interest among engineers and contractors, and I have been asked to write a brief sketch outlining the general situation and design methods.

The need for sewerage extension was very apparent before 1920, but the city was not permitted to issue bonds before that date due to war conditions. In fact, the Capital Issues Committee in Washington was very positive in its refusal.



RELATION BETWEEN TIME AND INTENSITY OF RAINFALL AT DETROIT, MICH.

On the basis of 1918 prices for labor and materials, it was estimated that it would require $60,000,000 to build trunk sewers in the newly annexed districts, two relief sewers in the central part of town, sanitary interceptors to the sites of the three proposed sewage-works, and the units needed at the present time at the three plants just mentioned. On this basis, in 1920, a $31,570,000 sewer bond issue was authorized—$6,570,000 by the Common Council in the yearly budget and $25,000,000 by popular vote. The understanding was that the remainder would be authorized when needed. This money was made available in a lump sum, leaving the Department of Public Works free to apply it to the general plan in whatever way seemed most advisable. This system has been found very convenient to the Engineering Department, saving transfers of funds to cover deficits from surpluses and providing funds for emergencies.

The chief of several reasons for the city being confronted with a sewage program of this magnitude was its extremely rapid growth in both area and population from 1915 to 1920 (see table). Between 1915 and 1917 the area of the city practically doubled.

For a number of years before the war there was a tendency to underestimate either the rate at which the city was growing or the importance of keeping pace with this growth with sewer construction. When these things were recognized the added burden of catching up in some of the older sections was attached to the problem of furnishing drainage in the newer sections.

Sewage-Treatment Problem—The third phase of the problem was the question of sewage treatment. Detroit has always discharged its sewage into the Detroit River without treatment. The river has a steady year around flow of about 210,000 sec.-ft. This heavy dilution, up to recent years, has kept the nuisance created within reasonable bounds. However, the rapid growth of the city and surrounding territory and the extension of the sewer system has brought the question of sewage treatment to a point where it cannot much longer be ignored. The question of sewage treatment was given quite a thorough preliminary study by C. W. Hubbell, who made a report to the city before he became city engineer in 1916. He worked in close conjunction with the International Joint Committee on Pollution of International Boundary Waters. Mr. Hubbell's report covered the Detroit River only, while the International Joint Committee covered the whole boundary between Canada and the United States.

The two reports agreed that an average pollution not to exceed 500 B. Coli per 100 c.c. in the river was a reasonable index of the pollution permissible. The dilution of the river does not produce anywhere near this minimum requirement at the present time and treatment will be necessary in the near future. All the new work in connection with the sewer system is being done with the treatment feature in mind. Diversion chambers, interceptor crossings and like accessories are being built into the new sewers. One of the three proposed sites for sewage-works has been bought.

Detroit's Sewerage History is probably typical of that of the average American town. The first settlement in 1701 was on the river front in almost the exact center of the present city's water-front. It consisted of fifty French soldiers, fifty civilians and one hundred Indians. From that time to the present the town has had continuous and uninterrupted growth to a population of one million persons and eighty square miles of area.

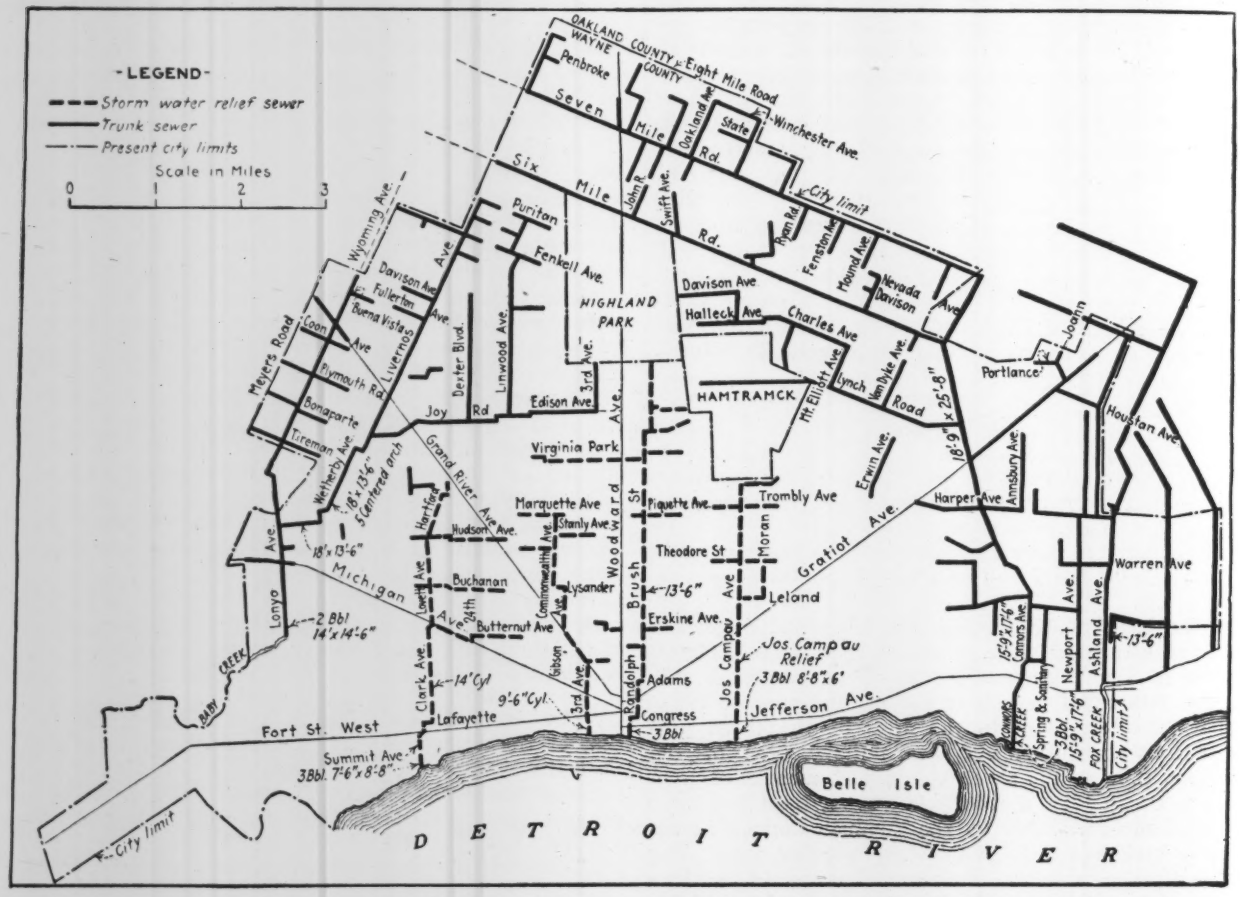
TABLE I—AREAS AND POPULATION OF DETROIT

Year	Area	Population	Year	Area	Population
1806	0.33	.....	1908	..	426,592
1815	1.36	.....	1909	..	440,412
1827	2.56	1,900	1910	..	465,766
1832	4.17	3,600	1911	..	499,030
1836	5.26	6,927	1912	41.76	536,139
1849	5.85	18,000	1913	..	567,920
1857	12.75	43,300	1914	..	595,000
1875	15.00	103,000	1915	46.97	678,746
1879	16.09	113,000	1916	70.66	734,562
1885	22.19	142,000	1917	78.69	820,778
1891	28.14	213,000	1918	79.62	900,000
1894	28.35	237 798	1919	..	950,000
1905	28.75	369,805	1920	..	993,739
1906	35.65	377,208	1921	79.92	942,373
1907	40.79	404,782	1922	81.42	1,000,000*

*Estimated.

The town has grown, fan-like, about the original center on the river front, roughly speaking, from seven to eight miles in all directions, except as limited by the Detroit River. As the limits spread along the river,

new trunk sewers were started inland, and as the expansion started inland, these trunks were extended to care for territory annexed. As these trunks were built little if any larger than necessary to care for ultimate development of what then constituted city territory, the continual extension inland soon tended to overload the sewers. Occasionally a new relief sewer would be built through the older territory, but on a scale that left the system as inadequate in a few years as the original sewers were when the relief was attempted. This was in brief the condition of the Detroit sewer system in 1915 when the area of the city was 41.76 square miles. Between 1915 and 1917 a belt of land



TRUNK SEWERS IN NEW TERRITORY AND RELIEF SEWERS IN OLDER PART OF DETROIT, MICH.
The trunk sewers are all finished or under contract. The storm-water relief sewers are all completed except the Clark Avenue Sewer which is under contract and partly completed.

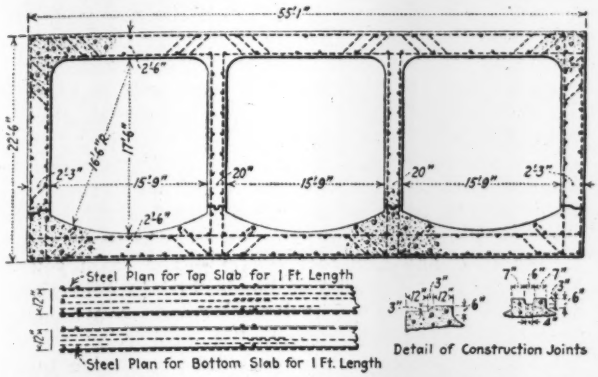
between two and three miles wide, surrounding the entire city, was annexed, making 78.69 square miles or practically doubling the area. The new territory was partly built up and new building was proceeding at a feverish rate. New families were pouring into Detroit to satisfy the industrial demand. The pressure brought to bear upon city departments for needed improvements was unprecedented. Transportation, pavements, water, gas, and other things were not of much use without sanitation, which brings us to the question of the general layout and design features of the new sewer system the city is now building.

All city work is based upon a local elevation datum in reference to which the river level is 95 ± and the highest point in the city in the northwest corner is at El. 178. The slope eastward and southward to the river is quite uniform and gradual and it was found convenient and economical to follow the natural slopes in laying out the system.

These figures also serve to indicate that the grades of the sewers have to be conserved. At no place in the entire system has it been found necessary or even possible to throw away grade with sudden drops. Velocities have been maintained between 5 and 15 ft. per second in the whole system, averaging probably between 6 and 8 feet.

The whole sewer system is of the combined type. About five square miles in the southeast corner of the city will eventually be made a double system, the present combined sewers being of just the capacity for sanitary drainage under ultimate development. This district is very low, parts of it being 2 ft. below river level. The sewage from it is now being pumped and always will be. A storm system will be constructed paralleling the present one.

The Rational Runoff Formula has been used in computing necessary capacities of all combined and storm sewers. By analysis of rainfall records of the past 26 years, the curve of rainfall intensities for design purposes (see diagram) has been taken as $i = 136/(t + 20)$. The coefficient of runoff has been set as low as 0.10 for park and cemetery areas with sandy surface soil and as high as 0.85 for fully built up and



CROSS-SECTION OF CONNOR'S CREEK THREE-BARREL REINFORCED-CONCRETE SEWER, DETROIT, MICH.

paved blocks in the business district. The average residence district is taken between 0.30 and 0.35; and the average neighborhood business district between 0.45 and 0.60.

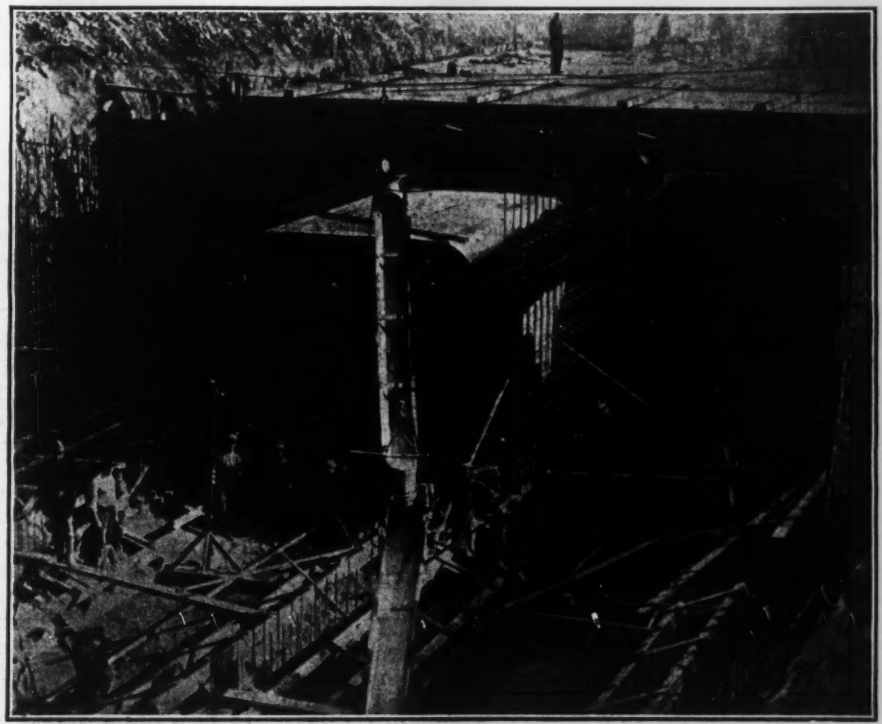
Up to a 50-minute period of concentration we have arrived at our required capacities by summation of quantities, being careful always to use the intensities corresponding to the time as we proceed down the system. Beyond the 50-minute period we have used the summation area method, applying intensity corresponding to time of concentration. This gives a somewhat smaller quantity to care for than summation quantity method, probably in the neighborhood of 15 per cent less in an average case. Others may use the rational formula in this way but so far as the writer knows the method is original with us.

We were led to the methods described by a study of local rainfalls over a period of about four years. Four rain gages were set up on the corners of a four-mile square. We found varying intensities in the same storm and that the centers of maximum intensity were of comparatively small extent compared with the whole storm. The design curve of intensities is naturally made up from the readings at a single location. If applied over too large an area this would lead to over-capacity sewers. Our figures showed that this factor could be cared for by changing from summation quantity to summation area method at from 40 to 60-minute concentration points. Usually we make the change at fifty minutes.

The design of the new sewer system can conveniently be divided into two headings: (1) Sewerage in the new territory recently annexed, consisting of a belt two to three miles wide surrounding the older portion, about 40 square miles in area; (2) storm-water relief sewers for the whole of the older territory, also consisting of about 40 square miles.

Two Great Trunk Systems—The solution of the first problem consisted of the design and construction of two great trunk systems, Lonyo Road and Connor's Creek (see map). Both start in the northwest corner of the city and follow the natural drainage lines to the river. The Lonyo system flows straight south and the Connor's Creek system flows east seven miles, then southerly about the same distance. A glance at the map will give a clearer idea of this layout than any lengthy description. The map shows only sewer mains. The vacant spaces are reached by laterals. The apparent irregularity of location of minor arms is due to topography and other local considerations, such as cemeteries, railroads, and parks. The Connor's Creek system passes north of Highland Park and Hamtramck, two separate municipalities, both entirely surrounded by Detroit, but with their own governments and local sewer systems. Both sewer systems empty into that of Detroit.

The drainage area of the Connor's Creek sewer is 41 square miles. Some of this is not now in the city limits but has been provided for. Under ultimate maximum conditions this sewer will carry 5,000 cu.ft. per second. The lower two miles consist of a three-barrel reinforced-concrete box section (see cross-section and view), each barrel being 15¾ ft. wide and 17½ ft. high. This section is laid on a 0.035 per cent grade. The section from Jefferson Ave. to Warren Ave., 7,700 ft. long, is just being completed at a contract price of $2,190,850 or $284.53 per foot. The four main branches of the Connor's Creek sewer are completed and in operation. These consist of the Lynch Road, Six-Mile Road and Seven-Mile Road sewers on the west and the Gratiot Ave. sewer on the east. The Connor's Creek



CONNOR'S CREEK SEWER, DETROIT, MICH., UNDER CONSTRUCTION
Each of the three reinforced-concrete barrels is 15¾ ft. wide and 17½ ft. high.

sewer itself is and will be built entirely in open cut while the branches are practically entirely in tunnel. These branches are at the present time emptying into the open creek and tend to create an unpleasant condition. Complaints have been received from residents in the vicinity. The city is heavily disinfecting the effluents but this condition cannot continue for long. This state of affairs has been caused by delays in court in regard to condemning rights of way through the creek bottom for the sewer. However, the Sewer Department expects to have the section extending from Warren to Lynch Road under contract and construction soon, the rest to follow shortly.

The Lonyo system is practically finished. Those small parts still under construction will be in operation by cold weather. The lower three miles of this system was all open cut and the remainder in tunnel. The Lonyo Road sewer itself is 8,318 ft. long and the contract price was $1,430,000 or $171.91 per foot. It is a double-barrel reinforced-concrete box section, each barrel being 14x14½ ft., on a 0.07 per cent grade. The system has a drainage area of 14.35 square miles, and is designed under maximum conditions to carry 2,530 sec.-feet.

The Wetherby sewer has a five-centered arch section, 18x13½ ft. The upper portion of the Connor's Creek sewer will also be a five-centered arch, but with dimensions of 25⅝x18¾ ft. Other sewers are generally of circular cross-section. Up to 6 or 7 ft. in diameter the egg section is sometimes substituted for the circle but this is generally, when done, for the purposes of gaining headroom for workmen, in tunneling, rather than for hydraulic advantages.

The drop in prices of labor and material in the last year and a half has caused quite a noticeable saving on the contracts let during that period over the amounts estimated during the war. In fact at least six large jobs and a number of lesser ones have been entirely financed out of this saving.

Relief Sewers—The problem of relieving the drainage system in the older section of the town is being met by the construction of large parallel storm overflow sewers from 1 to 1½ miles apart. Three of these, the Third St., Bates St., and Joseph Campau Ave. sewers are completed. The Clark Ave. sewer is under construction and two others, one on the east side and one on the west side, are projected.

It is fortunate that in the early days it was customary to build the sewers emptying into the river with more or less free outfalls. In other words, 3 to 5 ft. of grade were thrown away at the start. In building the relief sewers this grade is conserved and, with the flatter grades possible in the larger sizes, it has been found fairly simple to intercept and relieve the old sewers with the relief arms. The new relief sewers will carry only the storm-water overloads, the dry-weather flow being kept in the original lines. This is done by making the relief connections above the dry-weather flow elevations, thus making it unnecessary to intercept the relief sewers with the cross-town sanitary interceptors leading to the treatment sites. The first and smallest of these relief sewers is the Third St., which is 9½ ft. in diameter. The Clark Ave. Relief is 14 ft. in diameter. The Bates St. is 13½ ft. in diameter and the Joseph Campau is 11½ ft. Two and possibly three other reliefs will have to be built. These, with the four now under construction or in use, will care for the portion of the town lying inside the new system as long as they last. The life of a sewer in Detroit is something we have never satisfactorily determined. Our velocities are not high and not much grit is carried. We have sewers eighty years old that are practically as good as new. The nearest we have come to a failure of a main sewer has been some shattering due to gasoline explosions. We have arbitrarily, therefore, set 80 to 100 years as the life expected.

Financing and Contract System—The main sewers are financed by the sale of bonds, and in general are built in the streets. The lateral sewers are assessed against the property served "in proportion to the benefits derived." This is a difficult provision to interpret. We assess the cost directly proportional to the area of the various parcels served. This is not always just but will have to serve until a better interpretation is adopted.

Our specifications for construction work are very similar to those of many other towns. There is nothing radical or new in them, but we feel that they are in good working order as questions of interpretation seldom come up. Contractors on all sewers are required to furnish two surety bonds on each job for 100 per cent of their bid: One to insure the city against non-completion of the work and the other to insure the state against non-payment of sub-contractors, wages or materials.

To expedite this large program, Detroit has been using, since August, 1920, a form of contract which provides a penalty for non-completion by a date set in the advertisement and written into the contract. This penalty takes the form of liquidated damages and amounts to about 6 per cent of the contract price per year. On large jobs this runs as high as $500 per day. No bonus is offered for earlier completion. Quite a number of adjustments on this basis have come up and no litigation or serious difficulties have been encountered in operating this contract. No new contracts are entered into with a contractor while he is in arrears in time.

The chief credit for whatever has been accomplished in the sewerage line is due C. W. Hubbell, city engineer of Detroit from 1916 to May, 1922, at which time he resigned to devote his time to his private practice. The writer also gratefully acknowledges the conscientious efforts of the young men composing the sewer division of the office.

Ditching with Dynamite

A demonstration of ditching with dynamite was part of the exhibits at the National Drainage Congress in Kansas City and is reported as follows by J. W. Dappert, consulting engineer, of Taylorville, Ill. The charges were planted in three rows and 18 to 24 in. apart in each row. As the earth fell it scattered widely so that very little fell back into the ditch. The explosion left a straight and fairly uniform but not large ditch, with slopes and beds well shaped, but with much loose material. A rough estimate of this work is as follows: 2,250 sticks were used, 40 per cent nitro-glycerin, or 562½ lb. At a market price of 25c. per lb. this would cost $140.62; labor, transportation, placing, fuses, etc., would bring the total cost to about $163. The ditch was about 1,000 ft. long and averaged 3 ft. deep, 2 and 12 ft. wide at base and top, giving 780 cu.yd., or about 20.9c. per yard.

Recommended Changes in Highway Contract Practice

Contractors Formulate Improvements Designed to Reduce Risks and Increase Performance—Legislative Action Urged

SUBSTANTIAL improvement has been made in the last three years in the business relations between road contractors and highway officials. It has, however, been an improvement solely of individual relations—between a contractor and the engineer over him or between a state group of contractors and a state highway department. Contractors as they are nationally organized and highway officials as they are nationally organized, are still intolerant of each other's claims, although it will be three years ago in December that a joint committee of the two national associations was created to bring them into closer harmony. The committee's labors have been ineffectual. Indeed it is no secret that intolerance within the committee has prevented it from functioning in any definite manner. The situation requires intelligent treatment.

There is no real question between highway officials and contractors of their mutual obligations. The contractor expects to build a road of the kind and quality specified. He asks a reasonable profit for his work. He also asks that restrictions and risks which do not benefit the quality of the work but do hinder his chances of making a profit shall be eliminated. Highway officials allow all these requirements. Dispute begins when agreement is sought on the contract and construction restrictions which are permissible and necessary. In brief, there is no substantial difference of opinion between contractors and highway officials on the general principles of their contractual relations, but there is a dispute concerning details.

In view of the serious situation which appears likely to confront highway officials and road builders due to a growing reaction of public sentiment against increased expenditures for highway improvement all dispute within the road building industry should be smoothed out. The first step in the particular question being considered is to get a clear understanding of the subjects in dispute. They were briefly stated in these columns (*Engineering News-Record*, Jan. 1, 1920, p. 15) following the appointment of the joint committee of the Associated General Contractors and of the American Association of State Highway Officials to take the question under advisement. Since then opnion has been somewhat modified and conditions have altered so that a restatement appears quite different from the original statement.

The subjects which contractors, as represented by the Associated General Contractors, ask state highway officials to take under consideration may be grouped under three headings: (1) Contract obligations, (2) Award and administration of contracts and (3) Legislative action. In the following presentation of subjects coming under each of these heads it has to be kept in mind that some may be modified, others eliminated and perhaps new subjects added, when the committee actually begins its deliberations.

Contract Obligations—On the question of contract obligations the practices in which contractors ask modification are: (1) Allowances for extra expense; (2) classification of unit quantities; (3) acceptance of work and (4) payments.

Extra expense is caused the contractor when operations are delayed or suspended by action of the highway officials, or when the original quantities are materially increased or decreased or when materials once inspected and approved are rejected upon reinspection. It is urged that an adjustment of contract prices should be recognized as obligatory under these circumstances. In particular, it is contended that a limit should be stipulated beyond which the amount of work cannot be increased or decreased without adjusting the contract price.

Incomplete classification, particularly of excavation, and the grouping of different kinds of work under a single unit prevent accurate estimating and should not be practiced. Another grading operation that is at present not definitely specified is overhaul. A general modification of specifications for overhaul seems required to set a reasonable free haul limit of probably not over 500 ft. and to establish a standard method of accurately computing overhaul.

Arbitrary practice prevails generally in accepting highway work as completed. Delay, maintenance requirements and retained percentages tie up the contractor's funds and prevent prompt shifting of plant. It is believed that this situation can be materially improved by laying down the rule that acceptance is constituted by opening the highway to traffic and by eliminating maintenance provisions. A guarantee of the quality of the work for a year is suggested, in place of a maintenance requirement. Such a guarantee, it is held, is sufficient to protect the highway department against faulty construction and the contractor is not hampered in his future construction operations by the necessity of keeping organized and providing capital for maintenance work.

By the same reasoning, retained percentages ought to be no greater nor the money held longer than is absolutely necessary for a safe guarantee that the work will be completed. It is submitted that this requirement is met when the amount retained is not more than 20 per cent and, after work has reached a certain stage of completion, when the total sum retained is not increased, but, if possible, reduced. Prompt payments on a definite date each month and within a definite period after the completion of the work remove another financial handicap which is common.

Award and Administration of Contracts—Irresponsible bidders have been so common in highway work that forfeiture of contracts and financial failure have increased the difficulties of securing liability insurance and of obtaining loans from the banks. Wrong price standards have also been set up, so that in many states contractors of the highest standing are making no effort to secure road work. To meet this situation it is urged that the practice be followed of eliminating unsuitable bidders before the bids are opened, such action being based, of course, upon a careful investigation of the bidder's past record, financial standing and experience. With this selection made it is urged:

(1) That the contract be awarded promptly and certified checks be returned within a specified time.

(2) That an effort be made to secure the highest possible type of inspectors and field engineers.

(3) That unless a plan for the prosecution of the work is given at the time of sending out proposals, the contractor is to pursue his own plan except in emergencies endangering life and property.

(4) That when the contract specifies the methods to be followed it should not specify the results.

(5) That inspection of materials should be made at the source whenever it is practicable.

(6) That written statement be required of all important orders, particularly those involving delays.

Legislative Action—With a full understanding that highway officials in their acts and procedure are bound by legal restrictions which they cannot modify they are asked to co-operate with contractors to secure legislative action:

1. To enable the highway department to make adjustments of claims by the contractor for damages sustained from (a) orders, acts or omissions of the department and its employees and (b) causes beyond the contractor's control against which he cannot obtain insurance.

2. To repeal laws which prevent bonding companies from making reduced rates for preferred risks; i.e., to thoroughly responsible contractors.

3. To enable the department to reduce the surety bond as the percentage of completed work may warrant.

4. To make optional the substitution of collateral for a surety bond.

5. To establish a court of claims where the law prevents the contractor from suing the state for damages.

6. To make legal an arbitration clause in public contracts.

7. To make funds collected from automobile licenses over and above those required for maintenance, assignable to construction.

8. To make accurate and true cost accounting mandatory in all state construction performed by day labor.

9. To preclude bonding companies from writing bid bonds for any contractor to whom they are unwilling to furnish a surety bond.

The preceding statement of subjects and principles which contractors offer for the consideration of state highway officials is presented with the belief that it in no way jeopardizes the quality of highway work. Practically every provision has in some community or in some individual contract been tested out and found to work satisfactorily. They do not, it is believed, take from the engineer any prerogatives which he must have as the person ultimately responsible for the quality and perfection of the highway.

Putting New Foundations Under an Occupied Building

Work Done in Sections—Economical Combination of Deep Piers and Surface Footings for Heavy and Light Loading

RECONSTRUCTION of the foundations of a Chicago theater and office building without interrupting the occupation of either portion of the structure was accomplished as part of the work of modernizing the McVickers Theater. Special methods were used in carrying out the work. Another feature of this reconstruction is the combination of spread footings in the surface clay with deep concrete piers sunk to bed rock in open caissons. Fig. 1 shows the general scheme of the work.

The old building, which was altered this summer after the completion of the new foundation work, occupied a site 82 x 192 ft. fronting on Madison St., in the heart of the city. It consisted of a 7-story steel-frame office building 50 x 82 ft. at the street front and a theater in the rear, the theater entrance occupying the greater part of the first story of the office building. The foundation walls and footings were of stone, the footings being composed of large flat limestone blocks or slabs resting on the Chicago clay at about 2 ft. above datum or water level in the Chicago River. The load on the clay under the footings of the side walls was approximately 3 tons per square foot, which the reconstructed foundations reduce to about 1¼ tons.

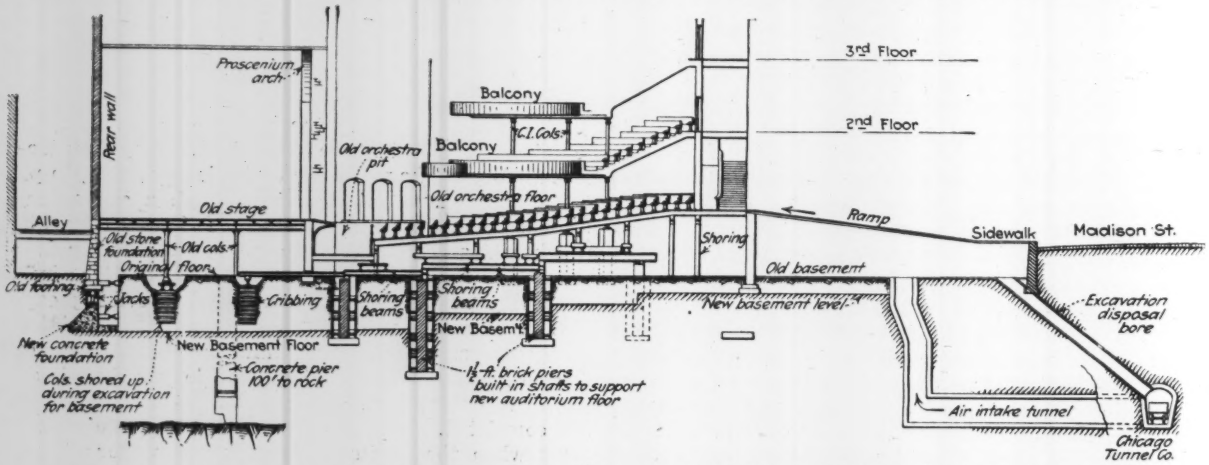


FIG. 1. NEW FOUNDATIONS PLACED UNDER THEATER AT CHICAGO, PRELIMINARY TO RECONSTRUCTION

In the theater, the main or orchestra floor was supported on brick walls and timber posts. A first and second balcony were carried by cast-iron columns on brick piers below the orchestra floor. The roof trusses of the theater were supported on steel columns anchored to the exterior brick walls and resting on the same foundations as the walls. These trusses, which will be retained, carried a two-story superstructure forming an extension of the upper floors of the office building, but this superstructure has been removed and will not be rebuilt.

In modernizing the structure it was decided to: (1) tear down the 7-story office building and replace it with a 3-story structure having the first floor occupied almost entirely by the theater entrance and the two upper

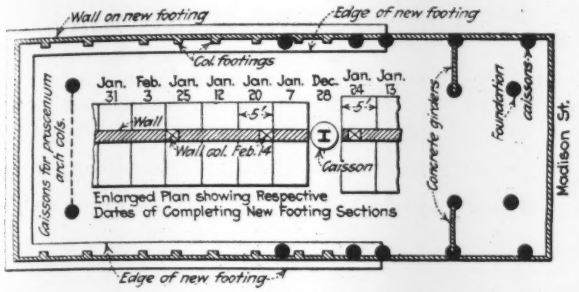


FIG. 2. COMBINATION OF SPREAD FOOTINGS AND DEEP PIERS

floors devoted to offices; (2) reconstruct the interior of the theater so as to eliminate all interior supporting columns and give an unobstructed floor space; (3) retain the old walls, foundations and roof trusses of the theater, underpinning the walls by new foundations carried to a greater depth and giving a wider bearing surface. In order to eliminate the former entrance ramp or incline which ascended from the sidewalk level to the theater lobby, the new orchestra floor and stage were planned at an elevation 4 to 9 ft. below the original level. This change necessitated deepening the basement by an amount varying from 2 to 9 ft.

A single steeply-inclined balcony will replace the two old balconies and will be supported by steel cantilever girders having their upper ends anchored to a steel truss and their lower ends seated in another steel truss spanning the main floor.

At first it was thought that it would be necessary to support the building entirely upon concrete foundation piers sunk to rock or hardpan. But in view of the relatively light wall loading of the theater section, where the walls carry little more than the roof trusses, it was decided that for this part of the building it would be sufficient to underpin the walls by concrete foundation walls having spread footings at an average depth of 9 ft. below datum. This arrangement also gives space for a new basement over the entire area. The arrangement of the new footing wall and foundation piers is shown in Fig. 2.

These new wall foundations, Fig. 3, are of mass concrete, having the inside face vertical and the outside face sloping at an angle of 45 deg., which gave sufficient

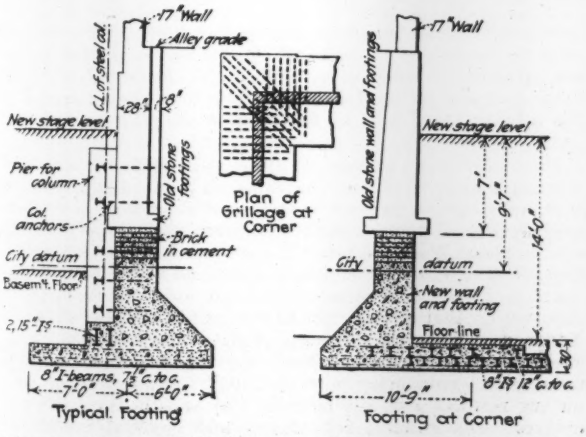


FIG. 3. UNDERPINNING OLD WALLS WITH NEW WIDE-BASE FOOTING

working room in reaching the desired width of footing. Below the basement floor the foundation projects 4 to 5 ft. on the inside of the building, thus giving a footing which varies from 10 ft. 9 in. to 15 ft. 10 in. in width. The footings were reinforced with a grillage of 8-in. I-beams spaced 7½ to 12 in. c. to c. By this construction the load on the clay is reduced to about 1¼ tons per square foot, as noted above.

The foundation walls were built in sections 5 ft. long, remote from each other, so that only small portions of the old walls were underpinned at one time. This is indicated by the dates on the portion of the progress plan in Fig. 2. During the excavation for a 5-ft. section the old footing was supported by posts and building jacks. Each concrete section was finished with its top 30 in. below the old stone footing course. After the concrete had set for seven days, building jacks were placed on the section of new wall and screwed up to take a bearing against the bottom of the old footing. (Fig. 4.) By this method of support any settlement of the new wall could be taken up by the jacks, thus maintaining a positive support for the building. As a matter of fact there was hardly any settlement. After about 60 days the jack screws were removed and the space between top of new wall and bottom of old foot-

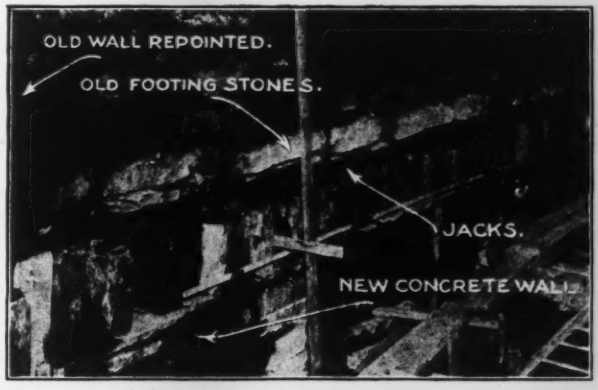


FIG. 4. JACKS PLACED BETWEEN NEW CONCRETE WALL AND OLD FOOTING

ing was filled tightly with brickwork laid in cement mortar. Finally the projecting portion of the old stone footing slabs on the inside of the building was broken off by means of pneumatic drills.

During this foundation work the wall columns supporting the theater roof trusses were shored up on needle beams supported by timber cribbing which was built up from the new footing level and at a little distance from the wall. To permit removal of the foundations of interior columns which carried the balconies and orchestra floor, groups of I-beams were placed in the most convenient positions. Cribbing or blocking was built up on these beams. Jack screws between the cribbing and the old floor framing transferred the load to these temporary supports, leaving the old pedestal and footing free for removal.

The shoring I-beams were supported in part on new brick piers which will serve to support the new auditorium floor. These piers were built in circular shafts just large enough for bricklayers to work, the bottom of the shaft being enlarged for a concrete footing course resting on the clay.

For carrying the heavier loads, sixteen concrete piers were carried down to bedrock at about 100 ft. below datum. Two of these support the truss over the proscenium arch; four carry the trusses forming the fulcrum and rear anchorage for the balcony cantilever girders, and the others support the framing of the front part of the building. These piers are 4 to 5 ft. in diameter and were built in wood-lined open wells or caissons in accordance with usual Chicago practice for deep foundations.

All reconstruction of the foundations was done without closing the theater or office building. Supplies were delivered from an alley at the side of the building. No excavated material was hauled away on the street as all this material was dumped down a chute into cars of the freight tunnel system and hauled away for filling on the lake front. A ½-yd. motor-driven concrete mixer was operated in the space excavated for the new basement. Work was carried on in three 8-hour shifts per day and a total of about 60 men on each shift were employed during the heavier part of the job. Work was commenced on Dec. 12, 1921, and was completed on May 1, 1922, with the old building seated on the new foundation walls and concrete piers ready for the alterations to the superstructure.

This foundation work was planned and carried out by the L. P. Friestedt Co., Chicago, under the personal direction of S. M. Gooder, general superintendent. The architects are Thomas W. Lamb, New York, and Henry L. Newhouse, resident architect, Chicago. J. G. Glaver, Chicago, is the consulting engineer for foundations and structural design.

Achorutes Viaticus Clean Sewage Filters

THE inoculation of percolating sewage filters at Glasgow, Scotland, with the insect *achorutes viaticus* for the purpose of cleaning the filtering material, and particularly to prevent ponding, has been successfully practiced during the past summer, according to a letter received by *Engineering News-Record* from F. W. Harris, corporation chemist and city analyst of Glasgow. Experiments with this method were begun on Jan. 21, 1921, on two filters each containing 2 cu.ft. of whinstone—the material used in Glasgow sprinkling filters. Later in 1921, boxes of whinstone, inoculated from the small test filters were embedded in the top layers of the regular filters. The original tests and the further working trial just mentioned were described in *The Engineer*, (London), for Feb. 10, 1922. Regarding the experience of the past season, Mr. Harris writes under date of Sept. 13, as follows:

Although my method of inoculation was adopted in the early part of October, 1921, the results obtained have been remarkably good in spite of the fact that the "trades waste" character of our sewage, the large sized smooth surface media, and the exposed position of our filters are conditions unfavorable to rapid propagation of these insects. Within the last few weeks ocular evidence has been obtained that the area, slightly exceeding 2¼ acres, of our percolating filters has been thoroughly inoculated and, in the greater part, well colonised with these insects, with the result that considerable sections which had previously been constantly "ponded" are now perfectly clean. The surface media is almost in as clean and open a condition as when the filters were first started.

In his article in *The Engineer*, Mr. Harris credits A. Bell, chemist and manager of the sewage-works of Barnsly, with having "first established" this method.

Partners in a Great Adventure

The Relations of the Engineer and Contractor as Seen by the President of the Associated General Contractors

Extracts from address by Arthur S. Bent, President of the Associated General Contractors of America, before the Los Angeles Section of the American Society of Civil Engineers.

THE CONTACT between the engineer and contractor should always be one of mutual confidence and cooperation but this is made difficult under the common form of contract which at once sets up an abnormal relationship. Their interests do not run altogether parallel. There is a fertile field for mutual irritation and distrust. The contractor, while we may safely credit him with a desire to do a good job, is primarily in the business to make money and he can't help viewing the acts and attitude of the engineer in the light of their effect on his profits. The engineer is chiefly concerned with the satisfaction and credit he will get from a first-class piece of work. Usually he is generous enough to hope the contractor will make money, but of course he feels no responsibility about this. In the contractor's heart, born of his experience, there is always the feeling that he will be made the "goat" in many little ways, perhaps in big ones, and that he is pretty sure to suffer some injustices on every contract. In the engineer's heart, on the other hand, is the fear that if the contractor isn't watched he may "scamp" the job, or at least neglect it. Such a mental attitude as this is obviously a brake on progress and a heavy handicap to the thing we both are trying to do.

I firmly believe that the origin and foundation of this attitude is the form of contract under which we ordinarily work. In its development one party to it has no voice. It is drawn up for the owner. In every line it breathes distrust of the other party. It is full of drastic provisions which indicate complete lack of confidence in the contractor.

It is true that the unfair contract is seldom written by the engineer. It is the ingenious deviltry of the owner's attorney, whose sole function is a conscientious and cold-blooded effort to secure every possible advantage for his client. Whatever its source, it is out of joint with the spirit of business today. "Caveat emptor" is now a business barbarism. Today we say, "Live and help live."

For more than a year committees from your organization, the Associated General Contractors, the architects, the railway engineers association and the highway engineers have been working together earnestly to develop a fair type of universal contract, which when completed, it is hoped, will receive the formal sanction of these bodies and be officially adopted by them. These contracts will cover the fundamentals of the four great divisions of construction—railways, highways, buildings and public works, and it will only be necessary to make them fit local conditions and specifications in each case. With the official adoption of these contract forms, I firmly believe that three-fourths of the litigation and half of the friction will disappear.

Engineers and Contractors Differ.—In spite of some unfortunate aspects of our contracts, and the disagreements that arise under present systems, able and conscientious engineers have the complete confidence and respect of the contractors. We learn much from you. We are also aware that practically every engineer is sure he would be a better contractor than any he ever saw, and we know from much observation that 99 per cent of you would be dead failures. You can and do put through great projects without contractors. Sometimes you beat our bids (though there is usually an explanation when you do). Often you improve on our methods and equipment. But you do this with the owners' bank account behind you and physical results as your main goal. You are very successful as a department of a contracting organization, but almost always, when you step out into the strictly competitive field, as we have to go,

get your work by being the low bidder for it and put into it your little ten or twenty thousand dollars that you have accumulated, you come quickly to grief.

I have seen many, many such failures and, pondering much over them, have concluded that the answer is one of psychology. I think that which makes a good engineer, the temperament and tastes and abilities which make for his success, *cause* his failure as a contractor. If he is capable of being a good engineer, he is congenitally unfit to drive a bunch of laborers over onto the right side of the ledger, or to bulldoze nature, or to wrest success *with profit* from crude and adverse conditions.

I hope this is so, for I believe there is a full field of usefulness for you and also for us. I think it is an economic mistake when engineers try to eliminate the contractor or are unwilling to let him have private work at a fair profit. I think you should never begrudge us good prices. I think you should try to build us up so that you can have our experience and our organizations and our responsibility to depend upon—available when you need them.

We contractors believe that our craft is the orderly development of a legitimate function. We are convinced that desirable economic conditions flow from this set up. Society needs the contractor, the man who builds up a great fabric of experience and skill and organization and appliances and holds them ready for responsible public service.

Day Labor Versus Contract.—If this is true, then your position is unsound when you recommend or undertake construction work with your own forces, particularly public work of importance. If this is right, it is right all the time, and a final analysis finds the Associated General Contractors and the entire construction army, built up by an endless process of specialization and elimination, swept into the discard. Don't you think this would be a disaster to society? Private construction would then inevitably be the victim of hopeless incompetence, now eliminated by the fierce fire of competition. Public work would become the plaything of politics.

What arguments are there for not letting work out by contract? The common one is that the contractors' profit may by combinations be made too high. I want to assure you that general contracting has passed out of the era of combinations, and it is today absolutely impossible to "frame up" an important piece of work. If bidding is genuine competition, is it to be assumed that all of these great construction organizations, carrying their loads of overhead whether working or not, are willing to let these jobs go by unless they can make exorbitant profits? As a matter of fact we cut our costs as low as we dare go, in the hope of landing jobs, and then add from 10 to 15 per cent.

Do you feel, as engineers, that there is any obligation on you, or that it is worth your while, to gamble in an effort to save part of that per cent; and are you justified in believing that, in spite of his life-time of struggle in the game, you can beat the contractors' costs? You cannot know that bids will be too high until you get them, and you do know how often the opening of bids reveals a gratifying reduction of the engineer's estimate.

Creators—Not Gamblers.—To summarize: The constructor is the precursor of every form of human activity. He cannot be spared. We, like you, are personal service agents. That is the only thing we have to sell. We are creators, not gamblers. The things other men produce remain only materials, commodities, passing through many hands and growing constantly more costly but not more useful, until finally the constructor takes them and transforms them into permanent structures, accomplishes their final destiny of usefulness to man, from which there is no further change. If he fails to do his work well, all that has gone before has failed, too. If he does it well, he is the fruition of a thousand hopes. Is such an agent to be hampered by distrust and injustice? Or should he be upheld, and helped, and encouraged? Should we secretly rejoice when we get the work of his hands for less than it cost him, or should we want him to be well paid for work well done? Should we undermine him and set him aside and find ways to do his work without him, or should we build him up in honorable usefulness and strengthen his character and his hands for this special service to society? As he does his work well or ill, so communities thrive.

Co-operation Needed.—In all the transactions between men, their relations to each other are primarily determined by their attitude of mind and this in turn is largely the resultant of their estimate of each other. If I have before me a business meeting with a shyster lawyer, I approach it with a prejudice and suspicion which at the outset makes it almost impossible for us to work together, even though he might be in a position to serve my interests and be willing to do so. But if I have the same matter in hand with my banker, whom I have long trusted, our minds meet at once and the result is quickly and efficiently reached.

Contracting once was largely a gambling game that encouraged and developed sharp practices; today it is a highly systematized business conducted in all its larger activities upon a scientific basis. Once it operated under crude methods with primitive equipment; today it succeeds only by the highest efficiency, and is supported by a vast organization of designers and manufacturers who furnish it with highly specialized equipment for its efficient conduct. Once it was led by strong but untrained men, who by force of character or shrewdness had fought their way to the front; today its great forces are directed and co-ordinated by men of trained minds, of sterling character and of the highest ideals. The old unfair contract was the natural development of the old condition; today it is an obstructive misfit. Engineers are devotees of efficiency; you are its greatest bulwark. But efficiency in construction will always be based upon co-operation between the engineer and contractor. And such co-operation must rest upon a fair contract and upon mutual confidence.

A. G. C. Promotes Fair Play.—The Associated General Contractors, in working for this fair contract, is an organization of great power, with no aims that are not in public interest, with no secret activities, no veiled propaganda, no accumulated fund, no selfish purposes. Its administration passes at short intervals from group to group, over all parts of this country. Its ethics and objectives are as fine as any. This organization now says to the engineers and architects: "This is the new order we are bringing to pass, this is the new day in our great industry which we are hastening. You are our natural allies. We cannot succeed without you; so will you not stretch out your hand to us, divest yourselves of that old mental attitude of fear and distrust of us? It is now an anachronism, it 'doesn't belong.' Give us at the outset a contract that doesn't assail our self respect, doesn't announce in advance your expectation that we will prove both incompetent and dishonest. Help our success in our work by the same promptness and efficiency on your part that you demand of us. Stop letting us pay for your mistakes and omissions. See that we get our progress payment on the day it is due. Be zealous to give us the final acceptance at the earliest possible moment. See through our eyes, too. Treat us as you would if we paid half your fee. And learn then how marvelously our common life-work can be lifted up."

But most of all, we ask you to recognize that the old order has passed away, that the successful contractor of today deserves your confidence and respect, and that the construction industry and the vast public interests dependent upon it are entitled to results which can be achieved only by real co-operation between you and us.

Cement-Gun Concrete in Metal Mines

The Bureau of Mines of the Department of the Interior has issued a typewritten memorandum of 30 pp. entitled "Gunite in Metal Mines," by Byron Pickard, district mining engineer of the Bureau. It takes up in some detail the application of gunite in mining work, describes a number of installations, and gives several tables of costs, and a bibliography.

Unusual Lift-Locks Proposed For Rhine-Danube Divide

German Engineers Plan Lifts Greater Than 60 Ft., Using Hydrostatic Device and Special Counterweight Designs

IN CONNECTION with the projected canal to connect the Rhine and the Danube via the Neckar as described in *Engineering News-Record*, March 30, 1922, page 521, the engineers have encountered some exceptionally difficult problems in lock design. As explained in the article cited, the Neckar may be canalized as far as Plochingen, which lies at an elevation of 780 ft. above datum. Between this point and Ulm, the head of navigation on the Danube, the waterway must cross the plateau of the Alb, a distance of 14 miles, at an elevation of 1,830 ft. (Figs. 1 and 2). This means an ascent from Plochingen of 1,050 ft. and a descent on the south side of about 300 ft. to the level of the Danube. It is planned to overcome this great difference in level by 29 lifts, some of which may be in the form of ordinary locks; but the problem is much complicated by the absence of an adequate water supply for the summit level of the canal. If ordinary locks were used to make this ascent the water for this operation would have to be raised 300 ft. from the Danube to the summit level. Recourse must be had then to specially designed lifts, certain types of which are already in successful use. In some instances, however, lifts must be negotiated which are much greater than have yet been accomplished even by mechanically operated elevators, for no experience is available with any such structure having a lift of more than 60 feet.

FIG. 1. RHINE-DANUBE WATERWAY

Hydrostatic Lift-Locks.—Several designs have been proposed for installations that would make these lifts and at the same time involve the use of no water. One of these has been proposed by the firm of Grün & Bilfinger of Mannheim, who, working under the direction of the Southwest German Canal Association, have devised a so-called plunger lock or marine elevator. In this design a steel-frame truck carries a trough of water in which the boat floats while being raised or lowered. As shown in Fig. 3, however, the plunger lock differs from the ordinary mechanical lift, in that the weight of the truck, the trough and its contents is counterbalanced by the buoyancy of a large cylindrical displacement-chamber or float, so proportioned that when it is fully immersed as shown in the figure, it carries the total weight of the movable structure.

The power required then is only that needed to overcome starting inertia and friction losses. For lifting a 1,200-ton boat a height of 46 ft. it is estimated that not more than 5 kw.-hr. will be required. The speed of operation being assumed at 20 ft. per minute, the total rise requires 2½ minutes. If we estimate for entering and leaving the lift 7 minutes each way, the passage of the boat through the lock requires about 17 minutes. Working through 16 hours, 50 ships daily could be locked through, making a total capacity for the lock of 9,000,000 tons annually.

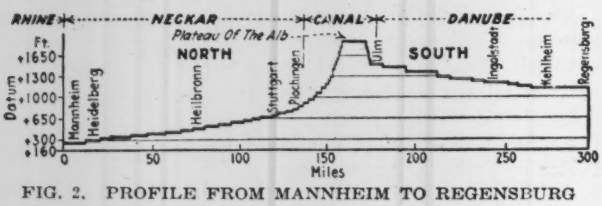


FIG. 2. PROFILE FROM MANNHEIM TO REGENSBURG

The water tank in which the displacement-chamber is immersed may vary in shape according to the nature of the underlying ground and other governing conditions. This device not only is easily adaptable to all sorts of topography but also is free in a large measure from structural and foundation difficulties, for by utilizing the buoyant effect of water a great reduction is effected in the loads for which provision must be made.

Application to Low Lifts.—In another form, the plunger lock is available even for lifts of only 16 to 33 ft., at a construction cost that would not exceed substantially the cost of a chamber lock of equal capacity. In this form the trough in which the boat is carried is inside the displacement-chamber (see Fig. 4). This chamber is a reinforced-concrete tube having an outside diameter of 50 ft. During operation this chamber rises and falls as with the type already described. At both ends of this chamber are reinforced-concrete collars or endwalls. In order that the interior of the chamber may remain in communication with the outside air during the operation of the lock, these endwalls are made to serve also as the end walls of the tanks in

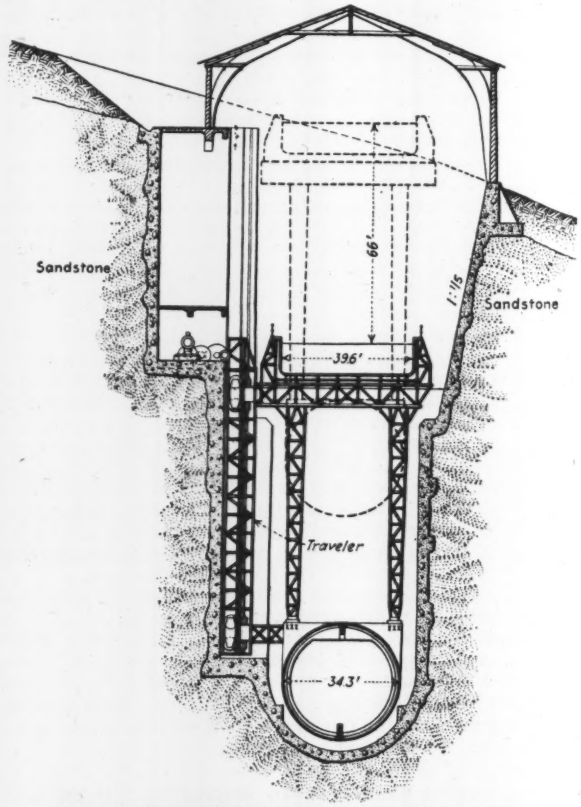


FIG. 3. PROPOSED HYDROSTATIC LIFT-LOCK

By the application of hydrostatic principles this design avoids the necessity for counterweighting and the structure that would be required to receive the great loads involved and distribute them over the foundation.

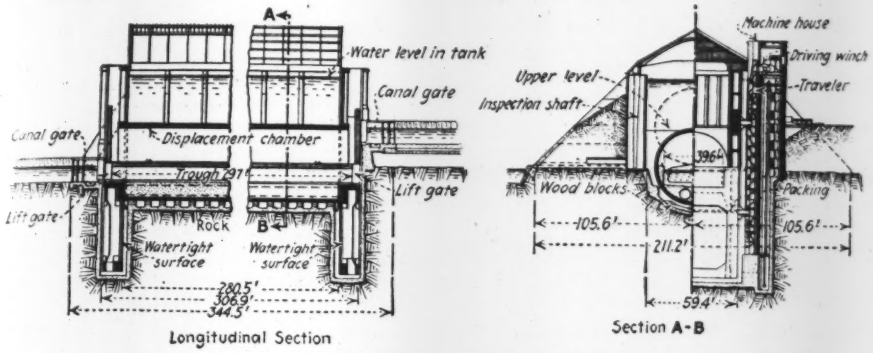


FIG. 4. PROPOSED HYDROSTATIC LIFT-LOCK FOR LOW LIFTS

In this type the displacement chamber is used also to contain the vessel being locked through. The reinforced-concrete end-plates of the chamber are rectangular and of such height and design that they form also the end walls of the tank in which the chamber floats throughout its travel. Lifting power is applied at both ends of the chamber.

which the chamber floats. This is effected by the use of water-tight packing between these movable endwalls and the fixed sidewalls. In this form the steel frame and moving traveler can be installed outside the water tank so that it may always be accessible. The driving machinery is even simpler than before and requires for lifting a 1,200-ton boat a height of 26.4 ft. not more than 3 kw.-hrs.

Economy of Hydrostatic Lifts.—An important advantage of these hydrostatic lift-locks is their exceptional economy. With a lift of 86 ft. as occurs several times in the crossing of the Alb, we have a cost of construction estimated at 3½ million marks (pre-war basis) as opposed to an estimate of 5.6 million marks for the cost of construction of two chamber locks in flight, each of 43-ft. lift and equipped with storage reservoirs for conserving water. The difference, it will be seen, amounts to more than 2.1 million marks. If we take into consideration also the cost of the necessary plant for pumping back the used water in connection with the storage reservoir; and the capitalized annual operating cost, the difference in cost between a lock of this design and a flight of chamber locks increases to about five million marks, all on a pre-war basis. This advantage diminishes, of course, as the lift decreases, but, varying with local conditions, it still obtains at lifts as low as 43 to 46 ft. For smaller lifts, down even to 23 or 30 ft., comparisons show that the second type, with boat inside displacement chamber, may be advantageous.

Counterweighted Lift-Lock.—Another design for a lifting installation has been prepared jointly by four engineering firms; Demag of Duisburg; Dyckerhoff & Widmann Co., of Biebrich; Gutehoffnungshütte, of Oberhausen and the Siemens-Schuckert Co., of Berlin, who specialize in crane design, civil engineering, structural design, and electrical apparatus, respectively. This scheme does not contemplate using the buoyancy principle but relies upon an ordinary mechanical lift, using counterweights to compensate for the weight of the trough and its contents. As this must involve the handling of heavy loads at considerable height, the supporting structure will necessarily be massive and require careful design to provide for uniform distribution over the foundation. The general appearance of the outside of such a structure is shown in Fig. 5.

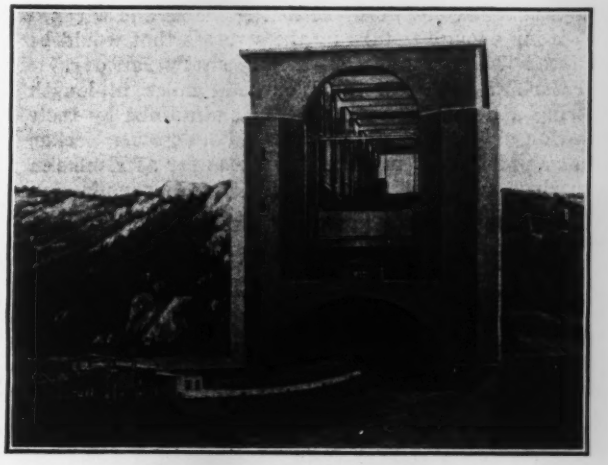


FIG. 5. COUNTERWEIGHTED LIFT-LOCK

In this design the tank and its contents are counterweighted, making necessary a massive supporting structure.

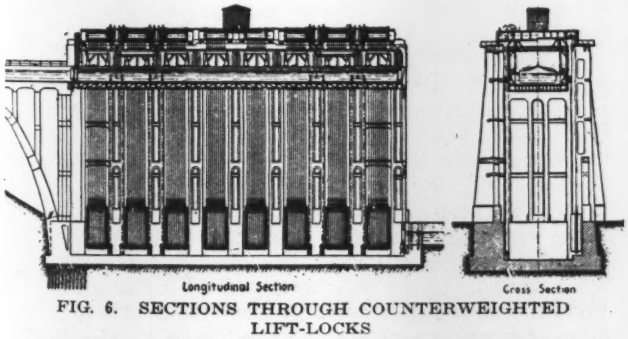


FIG. 6. SECTIONS THROUGH COUNTERWEIGHTED LIFT-LOCKS

The counterweight is divided into many small elements each supported by its own wire-rope but the elements of each group are so yoked together that failure of a rope simply distributes the load of its weight among the other ropes of the group. Lifting power is applied through compensating levers that insure holding the lift-tank level.

Both ends of the trough and of the canal reaches are closed by double-walled gates which provide security in case of damage to either inner or outer walls. The gates are raised by electrically-operated winches which are so interlocked with the main winding-gear that the trough cannot be moved while the gates are open and neither the trough nor the reaches can be opened unless the trough is in an end position.

Raising and lowering are effected by a number of electrically operated winches and endless link chains which travel over sprockets and are connected to the trough by a system of equalizing levers. (See Fig. 6.) These insure an equal distribution of the load and hold the trough level. Two sets of brakes are provided, one electro-magnetic and the other operated by compressed air. Both act automatically in case of accident.

The weight of trough and contents is balanced by a series of counterweights arranged in groups and suspended by wire ropes. As these weights are independent of each other, each rope has only to carry the assigned load; but a frame surrounding each group of weights prevents the fall of any weight. If one

rope should part the load of its counterweight would be distributed evenly among the remaining ropes.

Operation—Vessels are towed into the trough by electric capstans. The operation of the lift is automatically regulated so that it moves slowly until it is clear of the reach. It is then brought up to normal speed, which is maintained until it attains the other reach, when it is gradually reduced. A single locking requires about 17 minutes, ascent and descent requires about the same interval. As in all such cases more time is required to get the boat in and out of the trough than to perform the lifting operation. Owing to the counterweights, power is required only to overcome starting inertia and friction.

A distinctive feature of the design is the handling of heavy loads by subdividing them and distributing them over a large number of comparatively small carrying elements. In this way details are kept within limits that have already been proved adequate and safe in actual practice; and any damage element may be replaced quickly without disturbing the operation of the entire installation. In accordance with this principle, 160 parallel connected ropes are used to carry the trough and its contents. The lifting chains and winches are strong enough to take up the stresses that would be produced if the trough should accidentally run dry.

Water-Power—As a canal only 50 miles in length crossing a high plateau cannot be maintained by tools levied on shipping, it is planned to develop the Neckar as far as Mannheim and the Danube as far as Kehlheim to produce sufficient power to pay for the canalization of the Neckar and Danube as well as for the crossing of the Alb.

Under these conditions the tolls required on the entire canal will be about equal to those which are raised on the Rhine.

We are indebted for the information contained in this article to Dr. Karl Haller, Regierungsbaumeister, Stuttgart, and Emil Krahnen, M.E., Duisburg.

Asphalt Paving Costs of 1916 and 1922 Compared

AN ITEMIZED analysis of the cost of asphalt paving in Chicago as of 1916 and 1922, based on actual prices, is contained in a report by F. J. Herlihy, general manager, White Paving Co., Chicago, acting for his own concern and the firms of R. F. Conway Co., and the American Asphalt Paving Co. The report is made to M. J. Faherty, President, Board of Local Improvements of Chicago, in rebuttal of charges made by the *Chicago Tribune* that asphalt paving bidding prices in 1922 indicate exhorbitant profits.

Comparison in detail is made of wages and prices, item by item, for 1916 and 1922. As summarized, the results are as follows:

Item	1916	1922
Concrete base: sq.yd.		
Materials	$0.5831	$1.046
Fine grade	0.0470	0.098
Mixing and placing	0.0899	0.185
Plant cost	0.0153	0.042
Total	$0.7353	$1.371
Asphalt: sq.yd.		
Materials	$0.5867	$0.9414
Plant charges	0.0830	0.1846
Plant operation	0.0766	0.2084
Hauling	0.1065	0.1879
Laying	0.0418	0.0869
Cement	0.0020	0.0035
Total	$0.8966	[illegible]1.6127
General overhead	$0.0382	$0.[illegible]70
Discount on bonds	0.0382	0.[illegible]70
Construction bond	0.0191	0.0[illegible]85
Field overhead	0.0680	0.[illegible]80
Total, sq.yd.	$1.7954	$3.[illegible]42
Profit	$0.1146	$0.[illegible]48
Bid price	$1.9100	$3.[illegible]00
Per cent profit	6.3	[illegible].6

These figures include pavement only. Grading costs are shown to have similarly increased as follows:

Item	1916	1922
General overhead, cu.yd.	$0.0144	$0.0544
Discount on bonds	0.0144	0.2176
Construction bond	0.0072	0.0272
Operation	0.6133	2.0367
Total	$0.6493	$2.3359
Profit	$0.0707	$0.3841
Bid	$0.7200	$2.7200

For curb and gutter construction at the two dates the figures given are:

	1916	1922
Total per lin.ft.	$0.5933	$1.1214
Profit	$0.0867	$0.1286
Bid	$0.6800	$1.2500

Pulling Concrete Piles at the Galveston Causeway

Utilizing Equipment on Hand 7,500 Piles in the Capped Bulkhead of Old Filled Portion Removed by Portable Derricks

TWO traveling derrick plants at each of three points were used to pull the 7,500 reinforced-concrete sheetpiles along the new portion of the Galveston Causeway where concrete arches to give a wider waterway have replaced the former earth fill held in place by bulkheads of sheetpiling. From 10 to 70 piles per day were pulled by each plant, the estimate being 30 piles per day minimum. The cost of pulling and loading on barges was $4.50 per pile; towing, handling and stacking cost $2 to $2.50 per pile.

In the original construction the approaches consisted of an earth fill confined between parallel rows of sheetpiles driven 150 ft. apart with their tops projecting 4 ft. above mean low tide. The top was a reinforced-concrete cap, 18 in. high and 24 in. wide well anchored to the reinforcing steel which was left protruding above the pile heads. The piles were 10 x 18 in. in cross section, 18 ft. long and penetrated the fairly tough clay 8 to 10 ft. The confined fill was sloped upward on a 1 to 2 slope to El. 15 (zero is at mean low tide). This slope was protected by a lightly reinforced-concrete blanket 6 in. thick. The bottom of this slab was supported on top of the cap over the sheetpiling and its top was supported on the base of a concrete railing. The foundation of the railing rested on the sand fill.

During the 1915 tropical hurricane the gulf waters were carried with great force over the top of the causeway undermining the upper support of the slab by scour and rupturing it as it subsided. Passages for the water were opened and the sand fill was rapidly washed out letting the slab fall lower and lower until it became a heap of wreckage, but the sheetpiling bulkheads were not damaged.

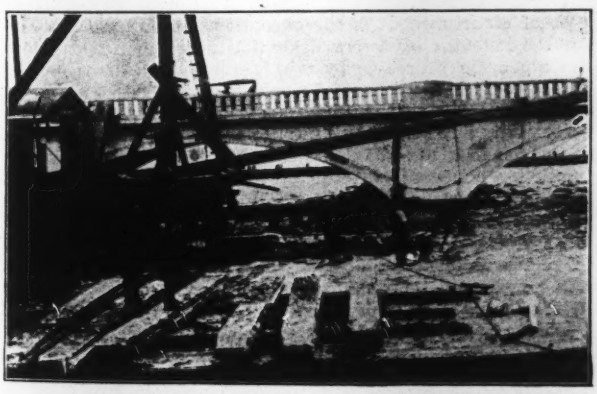
In the reconstruction of the destroyed portion of the causeway, which was begun in the latter part of 1917, the entire approach has been replaced with reinforced-concrete arches similar in design to the main structure which suffered no damage. This old arched structure consisted of 28 reinforced-concrete arches of a clear span length of 70 ft. each. The new or additional work consists of 28 arches on the Galveston

Island end and 51 arches on the Virginia Point or mainland end of the causeway. All new arches have 60-ft. clear span and are supported on piers 10 ft. wide, making the span of additional arches 70 ft. c. to c. of piers. The arched structure is 63 ft. wide, thus leaving the two rows of sheetpiles 44 ft. from the arches on each side.

The sheetpiles, which extended 4 ft. above mean low tide, were considered an obstruction to the flow of water through the arches. As one of the main purposes in adopting the arch type of construction was to get a maximum of waterway, it was decided to pull all of the piles after completion of the arches. Their presence during construction was valuable as a cofferdam for excavation and foundation work as they were so closely and well driven that it required very little pumping to make dry excavation possible.

In deciding on the best and cheapest method for the removal of the piles, consideration had to be given to the various obstacles to be encountered. Floating equipment appeared to be the logical plant to be used but owing to frequent low tide conditions and a large amount of debris from old wreckage strewn along both sides of the sheetpile wall it was decided impracticable to use such a plant. Furthermore as no floating plant had been used in construction it would have had to be provided at great expense. A number of traveling derricks of heavy type from the construction plant were immediately available. It was also found that these derricks could be operated regardless of tide conditions. Therefore this equipment was used. One rail for the movement of the derrick plant was laid on top of the concrete cap; the other rail was supported on a line of old timber piles capped with 12 x 12-in. stringers which were driven as the work progressed.

The operations of pulling were as follows: One derrick was used to drive the piles for the track of which there was 300 lin.ft. used. It also removed all debris and wreckage found within reach of the boom. The boom on this derrick was headed in the direction of travel, the mast being placed over the concrete wall support. Following was the second or pulling derrick, which not only pulled the piles but also dismantled the track as it went along and loaded the withdrawn piles on pontoons. As fast as the wooden piles and stringers were dismantled they were floated ahead to the forward plant and redriven. This arrangement made necessary a minimum amount of piles, track rails and stringers all of which were from the construction material.



PULLING CONCRETE PILES AND LOADING ON LIGHT-DRAFT SCOW

Boom down giving a side pull to break bond and disengage pile. Derrick, supported on pile cap, is moved back at intervals, cap dynamited and pulling continued.

BULKHEAD OF FORMER FILL ACTED AS COFFERDAM DURING ARCH CONSTRUCTION

Dynamite was used in the removal of the concrete cap, which was shattered and then picked loose with picks. About six ½-lb. cartridges of dynamite were placed on top of the concrete cap every 5 ft., mud-capped with clay about 8 in. thick and discharged with electric exploders. About 18 ft. of cap was broken off at one time. The boom was then lowered and a side pull made on the sheetpiling to break the bond between the piles and to disengage the core lock binding them together. A chain sling was then made around the pile head, the boom raised and a vertical pull exerted lifting the pile out of place. After pulling 10 or 12 piles in this way, the derrick was rolled along and the operation was repeated. Most of the piles pulled came out fairly easily but in some cases it required as much as 45 min. to extricate one pile.

The water of the bay is very shallow and at low tide insufficient to float barges. Small gasoline tow boats were used in towing the piles away after pulling. Several small 16 x 30-ft. scows were built for a displacement of 6 in. light. They were able to haul the piles at the rate of 8 to 12 per load depending on the tide. At full tide the bay was usually so rough that navigation was impossible, making the removal of piles a difficult and rather expensive operation. The piles weighed nearly 2 tons each and had to be towed on an average of 3,000 ft. to a point where they were unloaded by a stiff-leg derrick to small tram cars pulled by a dinkey engine to the material yard, a distance of 1,500 ft. farther away. Here they were unloaded by another derrick and stored for further disposition.

This work was done by and under the immediate direction of H. F. Jonas, who took over the completion of the Causeway after the work was abandoned by the contractor, June 15, 1920. Prior to this date from Oct. 1, 1917, Mr. Jonas had been supervising engineer.

LETTERS TO THE EDITOR

This department aims to be a forum for the discussion of the views of engineers and contractors. The range of interest should be as wide as possible. Contributors are, therefore, asked to make their letters short.

A Tribute to the Late Thomas B. Bryson

Sir—The article in *Engineering News-Record*, Sept. 21, p. 493, containing a record of the career of the late Thomas B. Bryson, omits note of a very important and hazardous piece of work which occupied much of his time for two and a half years. During 1914, 1915 and 1916, the work of building the cofferdam for the 46th St. pier rock excavation was carried out by Holbrook, Cabot & Rollins under the direction of the writer. Very little knowledge was at hand concerning the exact action of the 70-ft. steel sheetpiles forming the core of a high gravity dam with a head of 55 ft. Much movement, which at times became alarming, took place. Mr. Bryson, as vice-president of the contracting firm, gave his constant attention to this work, and the writer desires to acknowledge in full his indebtedness to the memory of this great engineer-contractor for his having overcome many serious difficulties successfully.

CHARLES W. STANIFORD,
Former Chief Engineer, Dept. of Docks and Ferries, New York City.

New York, Sept. 22.

Which Is the Highest Dam in the World?

Sir—Permit me to ask a simple question to which engineers may give different answers: Which is the highest masonry dam in the world? This depends upon what one calls the height of the dam. Is it the distance from the top to the lowest point in the foundation, measured in a vertical line, or is it the elevation of the crest above the lowest point in the foundation, wherever it may be, measured, if necessary, in vertical offsets?

To take a practical example, based upon data recently furnished to the writer by the United States Reclamation Service: The elevation of the crest of the Arrowrock Dam above the lowest point in the foundation, which in this case is at the downstream toe of the dam, is 348.5 ft., while the vertical distance from the crest to the lowest point in the cutoff trench is only 326 ft. Which of these two distances is the height of the dam? It seems to the writer that the answer should be that the latter distance is, strictly speaking, the height of the dam and that the former is simply the elevation of the crest above the lowest point in the foundation.

If a railroad embankment were 50 ft. high, except near one of the slopes where the ground was 50 ft. lower, no engineer would call the height of this embankment 100 ft. If a rectangular tower were 100 ft. high, except at one corner where the foundation rock sloped to an elevation 50 ft. lower, the height of this tower would undoubtedly be called 100 ft. and not 150 ft.

According to information given the writer by engineers connected with the construction of the Camarasa Dam, built in Spain in 1918-20, this dam is founded on rock which is practically level, and its maximum height, measured in a vertical line, is 334.66 ft. In an article by W. Ranney in your issue of Aug. 17, 1922, the maximum height of this dam is given as 333 ft. Even if we take this figure, the Camarasa Dam is 4.5 ft. higher than the Arrowrock Dam, measured vertically from the top to the bottom.

New York, Sept. 22. EDWARD WEGMANN.

[Mr. Wegmann's next to last paragraph illustrates perfectly the difficulties involved in any definition of maximum height. He arbitrarily defines his embankment as a 50 ft. one and his tower as a 100 ft. one. Fifty feet above what; one hundred feet above what? Neither embankment nor tower presumably is resting on a plane perfectly horizontal except for a single geometrical point below the remainder.

Our opinion is that the Arrowrock Dam still leads the world from the viewpoint of bigness or maximum height, which is the most common and reasonable conception of magnitude of a dam expressed in one dimension. "How High Is a Dam?" is discussed at some length in our editorial pages this week.—EDITOR.]

The Use of Diagrams for Reinforced-Concrete Design

Sir—In considering design in reinforced concrete we are faced at the outset with difficulties that do not occur with other materials. Bearing in mind that the best design is not necessarily the one that uses the least material or the one in which the material is most fully and uniformly stressed but is the one which fulfils best the requirements of the case with due regard to cost, it follows that a satisfactory standardization of reinforced-concrete sections is a difficult thing to attain by reason of the larger number of variables involved and the much more complex way in which they enter into the problem. Hence, in general, a far greater amount of individualistic designing is brought in.

Such work may be done in two ways, either by working out every case from first principles, using the standard formulas and methods based on generally approved assumptions, or by reducing these to the form of diagrams with or without making simplifying assumptions. Reinforced-concrete design, by reason of the cumbrousness of many of the rigidly correct algebraic expressions involved, lends itself naturally to treatment by graphical charts. It is an easy matter to prepare a set of graphs which will give the solutions of all the fundamental formulas for stresses, sectional areas, etc., and I have used a series of such charts to cover all ordinary problems of beams, slabs and columns where definite maximum unit stresses in concrete and steel are specified.

If plotted sufficiently carefully and to suitable scales such diagrams are capable of simplifying design arithmetic considerably without sacrificing in any way the accuracy of the algebraic calculation. Most of them can be found, either plotted right out or indicated diagrammatically in the principal text-books and involve no novelty of any sort. They are the limit to which it is possible to carry graphical treatment without introducing simplifying assumptions. It is this latter process which produces the crops of diagrams to which the articles in *Engineering News-Record* have from time to time referred, and the inexhaustible supply is due apparently to the large variation in the assumptions made.

In an endeavor to simplify as far as possible the routine of my own calculations I have examined at different times various diagrams and theories published in the engineering press. As a result I have become chary of accepting published charts without a rigid examination of the methods by which they are produced. The simplifications admissible in one case may be of dubious validity when applied to another type of structure. It is the exception rather than the rule for the inventor of a new designing diagram to enter into the algebraic processes by which his results are achieved and to publish the degree of accuracy of his chart in its applications. Yet it should be the rule. Otherwise serious errors may arise easily by the use of the diagram for cases for which it is not adapted. The user of the chart usually implicitly believes its accuracy and develops a faith in it born of a blissful ignorance of the shortcomings of its basic assumptions.

There are a number of calculations which frequetly arise in reinforced-concrete design where the only alternative to using a chart based upon approximations is to make tedious arithmetical calculations on the basis of trial and error. Such cases occur with beams and slabs which have to resist combination of direct and bending stresses. For these the graph is of great value provided its limitations are kept fully in view when it is being used. In a doubtful case stresses can always be figured as a check after the section has been designed.

I conclude, therefore, that the most suitable procedure in reinforced-concrete design is that in which the fundamental formulas are developed out in the form either of charts or

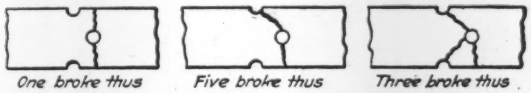
tables which are used to form the basis of simplified arithmetical work. This method absorbs somewhat more time in practice but has the great advantage of giving complete confidence in the results. If the office be one in which there is specialization in any particular form of structure it will pay to develop a series of standards adaptable to it. These can be determined once for all and tabulated in much the same way as structural steel details can, but a greater degree of latitude must be allowed in the standards if they are to meet successfully the more varying conditions of reinforced-concrete construction. It is unwise to use all-embracing diagrams unless fully conversant, by direct analysis and test, with their limitations, particularly when their origin and the process of their development is at all obscure.

London, Eng. E. G. WALKER, M. Am. Soc. C.E.
Aug. 1.

Net Section of Riveted Tension Members

Sir—Referring to Prof. C. R. Young's comment on my letter concerning net section in riveted tension members, in your issue of Sept. 21, page 490, I wish to point out two things. First, there is a distinction between a riveted seam in two tank or boiler sheets and a tension member that is perforated with holes for rivets. Second, the important question of economy enters in a way Prof. Young does not seem to appreciate.

As I stated in my earlier letter a plate seam has a zigzag



NINE TENSION TESTS ON PERFORATED BARS

line of holes, and each hole contains a rivet pulling against the metal. This constitutes a concentrated load tending to tear the plate beside the rivet hole. Naturally the zigzag line will be the one to rupture, and the stress will not approach uniformity between the rivets.

In a perforated tension member the rivets, excepting at the end connection or a splice, are merely holding the parts together and are under little or no stress. The stress of the member has ample opportunity to distribute itself, with approximately uniform intensity, over the area between the holes.

Of course the detail of the end or of a splice is a governing detail in a tension member, and, as Prof. Young points out, I emphasize this in my book; but it is also true that the end detail need not govern the section of the body of the member. In my book, "Steel Designing," page 202, this very thing is emphasized, for it is recommended that the rivets in the splice be tapered so as not to take out unnecessary holes in the body of the member. Also it is pointed out, on page 191, that the area beside a pin hole should be 50 per cent greater than the net section of the member requires. This corresponds in a measure to a rivet seam, where a concentrated load occurs at the rivet.

Another distinction between a plate seam and a structural member end connection is that the structural member has the rivets distributed along a fraction of the length of the member. The necessity of this, in good design, I also point out.

On the question of economy: If a rivet seam requires 10 per cent or 30 per cent excess area in a zigzag section, as determined by test, it should of course be so designed; and if an end detail requires like excess area, because of stress in the rivets, the same should be supplied. But it is not economical to penalize a bridge member perhaps 40 or 50 feet long because the end detail needs this provision. In proper design end details are commonly given excess area in any event.

It is in long angles of girders and tension members, which have several rows of holes, and in component plates of girder flanges and tension members, where the rule of adding 10 to 30 per cent extra area in a zigzag section means a large addition to the weight of a structure. This is not a mere academic question. It affects designing very vitally. It should not be determined on the basis of unsupported theory, especially a theory having no confirmation in tests. Tests of perforated plates, not of riveted seams, should be the criterion.

Prof. Young points out that some of my tests published in *Engineering News*, May 3, 1906, p. 488, are unsymmetrical, and therefore other effects are brought in. This is conceded, but he does not dwell on tests 28 to 36, which were symmetrical and which had three ways of breaking through the holes, one transversely through a central hole, one transversely through two half holes on the edges, and one in a zigzag line. All have equal area. I do not see how the ultimate unit stress in these tests, or any other of my tests, has any bearing on Prof. Young's theory. His theory is supposed to prove that a large percentage of area is required in a zigzag line for strength equal to that in a transverse line. If that theory is correct, every one of these nine tests, or of nine hundred, should break in the zigzag section. Not one of the nine broke solely in that section. One broke transversely through the central hole, five broke on the diagonal line on one-half of the bar, three broke on the diagonal line on one-half and simultaneously on the transverse and the diagonal line on the other half (see sketch).

This seems to indicate clearly that the strengths on the transverse and diagonal sections of equal area are about equal.

EDWARD GODFREY,
Pittsburgh, Sept. 30. Structural Engineer.

Painting Galvanized Sheets

Sir—There is apparently a wide difference of opinion as to when and how galvanized iron sheets for roofs of buildings are to be painted.

It is pretty generally accepted that new sheets are difficult to paint, and moreover the paint does not adhere to them as it should, owing to the grease on the sheets. Allowing the sheets to be exposed to the weather for several months before painting is probably quite a good method. It is not practicable to lay the sheets outside for the necessary time, and so they are usually put direct onto the building and after 6 or 9 months painted. This has one very bad feature, and that is that it is not possible to paint both sides of each sheet at the overlaps and also behind the purlins, girts, etc.

What is really wanted is a preparation to wash the greasiness off the sheets and still not destroy the zinc coating.

In Trautwine's "Civil Engineering," page 1162, he says: "Paint does not adhere well to new zinc, and this is the principal reason why new galvanized roofs are not painted; but this may be remedied by first brushing the zinc over with the following: One part chloride of copper, one part nitrate of copper, one part sal-ammoniac. Dissolve in 64 parts of water. Then add one part of commercial hydrochloric acid. Dries within 12 to 24 hrs. and may then be painted." Hool & Johnson's "Building Construction," page 1015, says: "If galvanized iron is allowed to weather for a year before painting, ordinary oil paints may be used, but if new the surface must be specially treated to enable the paint to adhere. A satisfactory method is to brush the surface of the galvanized iron with a solution of 6 oz. of acetate of copper to a gallon of water, allowing this to dry for about 24 hrs. before painting."

Objections have been raised to these methods on the grounds that the chemical action which takes place between the copper and the zinc is highly detrimental to the zinc. Is this the case? Has a solution of caustic soda ever been tried and, if so, with what results?

Owing to the large number of buildings throughout the world which are covered with galvanized sheets, I think it would be of great advantage to many people if the opinions of some of our well known authorities could be given through the medium of your valuable pages.

F. H. THOMSON,
Clerk of Works, Glenfield & Kennedy, Ltd.
Kilmarnock, Scotland, Sept. 26.

NEWS OF THE WEEK

New York, November 2, 1922

Dates Set for Hearings on Rail Consolidations

I. C. C. To Take Up During November Plans for Western Mergers—Southern Hearings Now On

With the approach of the dates set by the Interstate Commerce Commission for hearings on some of the important elements of its tentative plan for the consolidation of the railroads of the country into not more than eighteen or twenty groups, public interest has begun to focus on the proposal. At present three developments are in the immediate foreground.

At a hearing now in session in Atlanta, Ga., representatives of the Georgia, Florida & Alabama R.R., have suggested a system having as its main stem the Seaboard Air Line. The plan contemplates the inclusion also of the St. Louis-San Francisco Ry., from Memphis to Birmingham; the Western Ry. of Alabama, from Selma to Montgomery; the Southern Ry. from Selma to Meridian, and from Warm Springs to Columbus; the Alabama & Vicksburg Ry., the Atlanta, Birmingham & Atlantic Ry., the Carolina, Clinchfield and Ohio Ry., and the Georgia, Florida and Alabama Ry. Such a system, it is contended, would provide for an adequate outlet to the Mississippi, the Ohio, and the coalfields.

In the Northwest, the first hearing scheduled is for Nov. 17, when it is expected that the Great Northern, the Northern Pacific and the Chicago, Burlington and Quincy roads will try to convince the commission that they should be consolidated into one group. In the plan of the commission the Northern Pacific and the Burlington have been grouped with the Denver & Rio Grande, the Western Pacific and other smaller roads, while the Great Northern has been linked with the Chicago, Milwaukee and St. Paul, the Minneapolis and St. Louis and others to form another trunk system. The three roads that seek consolidation are the so-called Hill roads and now represent a community of interest, but the purpose of the commission is to provide a strong partner for the St. Paul so that there may be a fair competition in the northwestern territory.

The Western Situation

The situation in the far West will be aired at a hearing, called for Nov. 21, on the application of the Southern Pacific Co. for permission to retain control of the Central Pacific. Under a decision of the Supreme Court, that control has been dissolved as being a violation of the Sherman anti-trust law, but the Southern Pacific now applies under the terms of the Transportation Act of 1920.

This law gives to the Interstate Commerce Commission the authority to permit common control when it appears to be in the public interest. Meanwhile the Union Pacific R.R. is preparing to urge that the petition of the Southern Pacific be denied with a view to a later union of the Central Pacific with the Union Pacific itself. The Ripley plan upon which the Interstate Commerce Commission's plan was based, provided for such a step in order to complete the Union Pacific road from its present terminus at Ogden, Utah, to the coast; but the commission modified this plan so as to include the Central Pacific with the Southern Pacific, as was the condition prior to the decision of the Supreme Court. Public opinion throughout the territory served by the roads has been much aroused and both parties to the controversy are conducting campaigns of education to win public support for their contentions.

Meanwhile reports from Washington indicate that Senator Cummins is planning a move to make compulsory, rather than permissive, the grouping of the roads into a limited number of systems as is contemplated by the tentative plan of the Interstate Commerce Commission. According to Thomas De Witt Cuyler, chairman of the Association of Railway Executives, the railroads will adopt no policy with respect to such a proposal until the nature of the legislation had been clearly defined.

To Investigate Brake Equipment

The whole question of the adequacy of power brakes and appliances in use on the equipment of the railroads of the country is to be considered at a hearing Nov. 8 before Examiners Mullen and Borland of the Interstate Commerce Commission. One of the main questions involved is whether or not air-brake manufacturers are applying to their product the improvements which are available or whether the situation is such as to make it impracticable to apply commercially many of the improvements which are worked out but which for economic reasons, under present conditions cannot be applied promptly to the commercial product.

Permit Sought for Developing Mexican-U. S. Power Site

The first power project affecting the international boundary with Mexico, which has come before the Federal Power Commission, is that covered by an application of R. W. Morrison, of St. Louis. It involves the erection of a power dam 30 ft. high in the Rio Grande 10 miles above Laredo, Texas. No public lands are involved but Congress has declared on various occasions that the Rio Grande is to be regarded as navigable as far up as El Paso.

The Federal Power Commission cannot authorize the construction of that part of the project located in Mexican territory but it is understood that the necessary permission already has been obtained from the Mexican government. It is the intention to install equipment capable of generating 5,000 hp. to supplement the 5,000 hp. steam plant which now is furnishing the electricity used in Laredo.

Congress to Provide Funds for Waterways Projects

Important Items in River and Harbor Bill Include Projects on Three Coasts and Great Lakes

Washington Correspondence

Appropriations covering most of the river and harbor act, approved by the President on Sept. 22, will be made during the December session of Congress. The more important projects included in the act of Sept. 22 are as follows:

Expenditure of $10,400,000 has been recommended by the Chief of Engineers for the improvement of the New York and New Jersey channels. There is a demand for a better channel from Sandy Hook to South Amboy. An initial appropriation of $3,000,000 is desired, to be followed by such appropriations as may be necessary to complete the work in five years.

Proposed improvement of Newark Bay and of the Hackensack and Passaic Rivers calls for an estimated expenditure of $2,150,000. The plan is to dredge the channel in Newark Bay 30 ft. deep and 1,800 ft. wide at the entrance, narrowing to 400 ft. below the Central Railroad of New Jersey bridge across the bay. That width is to be continued to the junction of the dredged channels in the Passaic and Hackensack Rivers and up the Hackensack to the bridge of the Central Railroad of New Jersey; thence 20 ft. deep and 300 ft. wide to deep water 4,800 ft. above the Lincoln Highway bridge.

Other Recommendations

To extend the present sea-wall at Galveston to the south jetty will require an expenditure of $670,000.

Expenditure of $1,759,000 has been recommended by the Chief of Engineers for the further improvement of the waterway which extends from Sabine Pass through the Port Arthur and the Sabine-Neches Canals and the Neches River to Beaumont, Texas. Proposed improvements in the vicinity of Aransas Pass and the construction of a safe and adequate harbor at Corpus Christi involve an estimated cost of $5,051,900. The plan is to complete this work within two years.

The plan for the further improvement of the Monongahela River calls for the ultimate expenditure of $6,640,439.

It is proposed to improve Milwaukee Harbor by extending the present north breakwater 1,760 ft., so as to give a total length of 10,370 ft. A new south breakwater having a total length of 9,650 ft. has been recommended. The channel is to be deepened to 21 ft. The total estimated cost of the project is $4,000,000, with an initial appropriation that need not exceed $1,000,000.

The further improvement of the entrance to San Francisco harbor involves the dredging of the channel through the outer bar to a depth of 40 ft. and a width of 2.000 ft.

Road Engineering Education Subject of Conference

Educators, Engineers and Automotive Men to Harmonize Differences in College Curricula

Education in highway engineering and highway transport was discussed at a conference of educators, highway officials and representatives of the automobile industries in Washington, D. C., on Oct. 26, 27 and 28. About 400 delegates were in attendance. Addresses were given by leaders in the field and eleven committees sitting several hours a day brought in preliminary reports on various phases of college training in highway engineering and transport. These reports were referred to a co-ordinating committee which will formulate a recommended curriculum for engineering schools which wish to fit students for highway work.

Speaking of the opportunities for engineering college graduates in highway engineering, Thomas H. MacDonald, chief of the U. S. Bureau of Public Roads, pointed out that "on the basis of the more conservative estimate of actual expenditures, and without attempting to fix closely the proper percentage of cost for engineering services, there should be invested annually, at the present rate, for the engineering and administrative control alone, from 30 to 60 million dollars. The tendency of highway legislation is most favorable to the man who will consider the highway field as his future work. There are opportunities in more than a dozen of major fields directly connected with highway work. The rate of highway improvements has not kept pace with the demand which, together with the program now definitely recognized, make certain a long period of activity."

In the automobile industry and highway transport, C. C. Hanch, vice-president, Automobile Chamber of Commerce, urged the need and opportunity for college trained men for research, production, purchasing, sale extension and highway transport. So important is this supply of college men that the industry is now working out a plan by which close touch can be kept with graduates.

Highway Research

Research in highway engineering and particularly highway transport was urged by Dr. W. K. Hatt, director of the advisory board on highway research of the National Research Council. Pointing out that very few problems in highway engineering could be approached with any considerable number of determined facts, action was urged by engineering colleges to develop plans for research work.

Highway finance was the subject of an important paper by A. J. Brosseau, U. S. Chamber of Commerce.

Mr. Brosseau urged that five steps be taken to insure adequate and uniform financing. They are: preparation of a construction budget by every state; that cost of construction shall be borne by state bond issues; preparation of a budget of current operating costs; expenditures in all states should be under the supervision of the state highway department, and regulatory power should be as flexible as possible and lodged entirely with the highway department.

The highway education board under whose direction the conference was held and which will handle the educational committee reports and co-ordinate their suggestions into a specific course of college training consists of John T. Tigert, U. S. Commissioner of Education, chairman; Thomas H. MacDonald, chief of the Bureau of Public Roads; F. C. Boggs, colonel, Corps of Engineers, U. S. Army, representing the War Department; Roy D. Chapin, president of the Hudson Motor Car Co., representing the National Automobile Chamber of Commerce; Harvey S. Firestone, representing the Rubber Association of America; F. L. Bishop, dean, school of engineering, University of Pittsburgh, representing the Society for the Promotion of Engineering Education; H. W. Alden, representing the Society of Automotive Engineers, and Walton C. John, secretary.

Col. William D. Uhler

Col. William D. Uhler, for a dozen years a prominent figure in the highway field and since 1915 chief engineer of the Pennsylvania State Highway Department, died in Harrisburg, Oct. 27, after a week's illness. A cerebral hemorrhage occurred Oct. 23 and from then until the time of his death Col. Uhler was unconscious, his entire left side and throat having been paralyzed. During the war he served first with the rank of major in the Ordnance Department and later as lieutenant-colonel in the Motor Transport Division.

He was born at Nazareth, Pa., Nov. 8, 1872, and began engineering work in 1890 as rodman and instrumentman on the Lehigh Valley R.R. For the next 14 years he was engaged principally in railway work with the Lehigh Valley, the Maryland & Pennsylvania, and the Queen Anne's (later the Maryland, Delaware & Virginia) Ry.

His entrance into the highway field dated from 1904, following a period of six months at the U. S. Naval Academy as inspector in charge of quay-wall construction. His first highway assignment was as road engineer for Caroline County, Md., a position from which he was promoted four years later to be engineer in charge of maintenance for the Maryland State Roads Commission. In this post he continued until 1912 when he resigned to join the staff of the Bureau of Highways of Philadelphia as principal assistant engineer.

When Samuel D. Foster resigned as chief engineer of the Pennsylvania State Highway Department, Governor Brumbaugh selected Col. Uhler as his successor, effective April 7, 1915. He had been the engineering head of the Pennsylvania State Highway Department from that time until his death.

Col. Uhler has taken an active part in engineering society affairs, particularly as they related to road work. He was the American Society of Civil Engineers' representative in joint relations with other national societies and committees on paving brick. He is a past-president of the American Association of State Highway Officials and was a candidate, this year, for president of the American Road Builders Association.

The Engineer in Public Life

ARTHUR S. BENT

In spite of his responsibilities as senior member of the firm of Bent Bros., contractors, of Los Angeles, Calif., and president of the Associated General Contractors of America, Arthur S. Bent finds time for participation in a wide range of public activities. He is a director of the Merchants and Manufacturers Association of Los Angeles, an organization which has been credited with keeping Los Angeles industrially free for the last twenty years and which has a membership of thousands of business men. In addition, he is a director of the local Rotary Club, director of the Civic Development Department of the Chamber of Commerce of the United States, trustee of Pomona College, and a member of the Los Angeles Chamber of Commerce and the Municipal League.

He is the son of a mining engineer and was born in California in 1863 in the mining region of the high Sierras, near the Yuba dam. After attending the public schools in Los Angeles until he was sixteen years old, he started work as a reporter for the *Daily Express* of that city and after a couple of years of journalism he drifted into construction work and laid the foundation of the general contracting organization of which he is now the head. Included in the list of completed works which the Bent organization constructed are the Sweetwater dam at San Diego, the Gibraltar dam at Santa Barbara, half a dozen concrete-lined oil reservoirs, numerous water-works and sewerage systems irrigation works and a large mileage of California state highways.

Mr. Bent's technical associations, in addition to the Associated General Contractors, include membership in the American Society of Civil Engineers, the American Association of Engineers, the American Concrete Institute, and other organizations, national and local. His practical knowledge and experience are regarded as an important asset to the work of the Civic Development Department of the U. S. Chamber of Commerce, which includes service and assistance on organization problems of local chambers of commerce, education, housing, city planning, and zoning, citizenship, immigration, Americanization, and civic research.

To Take Bids on Narrows Tunnel

The Board of Estimate and Apportionment of New York City has approved the plans, specifications, and necessary bond issue of $575,000 to cover the construction of the Brooklyn shaft of the Narrows tunnel to Staten Island. Bids are to be opened on Nov. 24, 1922.

Engineers Explore Colorado River Canyons

Expedition Makes Trips in Small Boats From Above Utah-Arizona Line to Needles

A boat expedition through some of the canyons of the Colorado River both above and below the Grand Canyon has just been completed by a group of engineers and other interested individuals for the purpose of examining some of the principal dam sites of the various proposed developments now under consideration.

The expedition was arranged by E. C. La Rue, hydraulic engineer, U. S. Geological Survey, who had previously made two other exploring journeys over a considerable portion of the river. The other members of the party were A. P. Davis, director of the U. S. Reclamation Service, Col. C. R. Birdseye, chief of the topographic division, U. S. Geological Survey; R. E. Caldwell, state engineer of Utah; H. W. Dennis, construction engineer, Southern California Edison Co.; Charles P. Kahler, electrical engineer, Union Pacific System; Herman Stabler, chief engineer, Land Classification Board, U. S. Geological Survey; Clarence C. Stetson, secretary Colorado River Commission, Department of Commerce; Franklin Thomas, professor of civil engineering, California Institute of Technology; John A. Widssoe, ex-president, University of Utah, and R. D. Young, Mayor of Richfield, Utah.

The party reached the river in Glen Canyon at Hall's Crossing about 100 miles by river above the Utah-Arizona line on Sept. 7, after traveling four days, the last three by wagon, for a distance of 175 miles from the Denver and Rio Grande R.R. at Richfield, Utah. The descent of several hundred feet from the plateau country to the river's edge at Hall's Crossing, while the most favorable in a distance of 200 miles, is particularly hazardous because of steep grade and side slope, and one of the two wagons carrying the supplies and bedding of the party narrowly escaped sliding off the edge of the cliff where a freighter had met such misfortune a few years ago.

Awaiting the party at Hall's Crossing were five boatmen, who had brought up the river 120 miles from Lees Ferry four boats belonging to the Southern California Edison Co. These 18-ft. flat-bottom rowboats were lashed in two tandem pairs with an Evinrude motor on each stern boat. The start down the river was made on Sept. 8 with each of the boats carrying approximately 1,000 pounds.

The average slope of the river in Glen Canyon is slightly less than two feet per mile and, while there are several rapids in this portion of the river, all can be run safely in an open boat. The river channel is irregular and the boats frequently became grounded on sand bars or submerged rocks when at times it was necessary for crew and passengers to disembark and work the boats into deep water.

Nine possible dam sites were examined in Glen Canyon and detailed topography by plane table was taken at four sites.

The distance covered daily varied from ten to thirty-five miles. Night camps were located usually near sites which were to be examined and when possible at side canyons with tributary streams for water. Side canyons were not always available and the river water was palatable after an opportunity had been given for the silt to settle.

ONE-HALF OF THE COLORADO RIVER EXPLORING EXPEDITION

A side trip of great interest was made up Aztec Creek five miles to the great Rainbow natural arch. Aztec Creek enters from the east and is sixty-nine miles above Lees Ferry and nine miles below the mouth of the San Juan River. An easy walk of two hours took the party to this great wonder of Nature which has been visited since its first known sight by white men in August, 1909, by about a hundred people according to the register at the arch. The usual approach to the bridge is by stage for 120 miles followed by 80 miles with pack animals. The arch has a span of 275 ft., a rise of 300 ft. and the arch ring at the crown is 40x40 ft. in section.

Throughout Glen Canyon the width of the river surface varies from 500 to 600 ft. with the canyon walls rising abruptly in most places and frequently to heights of one thousand or more feet. The canyon lies in a red-brown sandstone of regular and massive formation generally free from bedding. Of the sites in Glen Canyon those in the lower portion just above Lees Ferry appear as most favorable, but accurate estimates of construction cost cannot be arrived at until borings are made to determine the depth of bed rock.

The party left the river at Lees Ferry on Sept. 18 and proceeded by automobile and truck 140 miles to Flagstaff, Ariz., where some of the members separated from the party. On Sept. 21 and 22 the James B. Girand power project was visited. This project which is located in the lower Grand Canyon at the mouth of Diamond Creek is reached by automobile and saddle horse from Peach Springs, on the Santa Fe R.R. Mr. Girand, who piloted the party to the river, was accompanied by Messrs. Davis, Stetson, Caldwell, Stabler, Kahler, La Rue and Lewis R. Freman of Pasadena.

The party just named then proceeded by rail to Los Vegas, Nev., and by U. S. Reclamation Service truck to Boulder Canyon on Sept. 24, where a 20-ft. rowboat was utilized to navigate through Black Canyon and on 110 miles to Needles, Calif., which was reached on Sept. 28 after encountering strong head winds for a considerable portion of this distance, which is for the most part in open country below the canyons.

Sanitary Section of A. P. H. A. Discusses Sewage Treatment

Fifty engineers attended the meeting of the Sanitary Engineering Section of the American Public Health Association, in Cleveland Oct. 16-19. Special attention was given to sewage treatment and to typhoid as an index of the purity of water supplies. George W. Fuller started the discussion on sewage treatment by an outline of the Lima situation similar to the one presented at the meeting of the American Society for Municipal Improvements reported in *Engineering News-Record*, Oct. 19, p. 658. Mr. Fuller stressed three points: the financial impracticability of the direct-oxidation process, the meager data available concerning that method and the degree of efficiency required in any treatment. The Section appointed a committee to investigate the process.

Langdon Pearse in a comprehensive study of the water supply, sewage disposal and typhoid of the larger cities on the Great Lakes elicited an extended discussion, the consensus of which was that typhoid fever death rates are still the best index of the quality of a water supply. Mr. Pearse also presented a progress report of the committee on sludge which was a duplicate of that presented to the A. S. M. I. meeting.

The committee on definition of sewage treatment terms had its report referred back for further consideration. A special committee on standard specifications for plumbing, with Paul Hansen of Chicago as chairman, was appointed to consider the specifications sent out by the building code committee of the Department of Commerce.

The Sanitary Section elected the following officers: Kenneth Allen, chairman, and H. A. Whitaker, vice-chairman. E. D. Rich, Lansing, Mich., continues for a second year as secretary.

Live Topics Feature Bridge and Building Convention

Concrete Piles, Painting Structural Steel, Framing Bridge Timbers Discussed at Cincinnati

Methods of handling and driving concrete piles; paints and painting for structural steel; concrete and steel tanks; pile-driving methods and records, and the framing of bridge timbers before treatment were subjects discussed at the annual convention of the American Railway Bridge and Building Association, held in Cincinnati Oct. 17-19.

Specifications for wood piles and precast concrete piles, together with the matter of pile-driving formulas from "Foundations of Bridges and Buildings," by Jacoby and Davis, were presented in a report which brought out some discussion as to the rule for straightness of a wood pile. In the opinion of G. W. Rear, Southern Pacific Ry., a variation not exceeding 1 in. in 10 ft. is permissible. The report on concrete piles dealt mainly with practice of different railroads, and opinion appears to favor jetting where this method is practicable.

CONCRETE PROMINENT IN DISCUSSIONS

High cost of concrete tanks is largely offset by long life and low maintenance cost as compared with steel and treated wood, according to a committee report. There seems to be little trouble with concrete tanks in severe northern climate and the early troubles in waterproofing appear to have been practically eliminated.

Concrete was again brought forward in the discussion of a report on labor-saving devices, when two or three engineers advocated the use of small concrete mixers in preference to hand mixing on small jobs and for preparing paving compositions for highway crossings. A great variety of devices were noted in the report.

That framing and boring of bridge and structural timbers is generally advocated was stated in another report, but the treated timber needs to be handled carefully to avoid breaking or piercing the outer surface. There is apparently some economy in framing at the mill rather than in the field, but no reliable figures are available, and in any case allowance must be made for additional cost of preparing drawings, marking material and selecting the parts during erection.

OFFICERS ELECTED

In painting bridges the spray machine was said to be increasing in favor and reference was made to the use of zinc, aluminum and other metallic powders in protective paints for metal in order to increase their rust-resisting properties. Prompt cleaning and painting of spots that show incipient rust was approved in the discussion instead of waiting until complete repainting is necessary.

The new president is Arthur Ridgway, assistant chief engineer of the Denver & Rio Grande Western Ry.; C. A. Lichty, Chicago & Northwestern Ry., Chicago, was re-elected secretary. The next convention of the association will be held at Seattle, Wash., in 1923.

Industrial and Economic Subjects Feature A.S.M.E. Meeting

The annual meeting of the American Society of Mechanical Engineers will be held in the Engineering Societies Building, New York City, Dec. 4-7. A feature of the meeting is the fact that joint sessions will be held with the American Economic Association, the American Society of Safety Engineers, the American Society of Refrigerating Engineers, and the American Engineering Standards Committee. The economic forum promises particular interest. Addresses will be delivered by Dr. W. C. Mitchell of the National Bureau of Economic Research and professor of economics at Columbia University, and Prof. H. R. Seager of Columbia, president of the American Economic Association.

Sessions of the professional divisions will cover a wide range of industrial and technical progress, including developments in aeronautics, fuel, management, forest products, ordnance, railroads, textiles, gas power, machine-shop practice, and material handling. Education will also be considered.

During the annual meeting John L. Harrington of Kansas City will succeed Dean Dexter S. Kimball of Cornell as president of the society.

Electric Steel Founders' Research Group Holds Meeting

The chief executives and the operating officials of the companies comprising the Electric Steel Founders' Research Group recently held a three-day meeting at Wernersville, Pa., at which exhaustive progress reports were presented on researches being conducted by the organization into annealing; core practice; facing practice; furnace practice, and the elimination of slag from castings. It is stated that there has been gratifying progress in each group investigation and that the improved volume of business in the industry at present affords better opportunity for the prosecution of certain researches than when operations were curtailed during 1921.

The group members report that the standardization of practices has recently been extended to cover methods of chemical anaylsis.

The group consists of the following companies: Electric Steel Co., Chicago; Fort Pitt Steel Casting Co., McKeesport, Pa.; Lebanon Steel Foundry, Lebanon, Pa.; Michigan Steel Casting Co., Detroit; and Sivyer Steel Casting Co., Milwaukee. The group began active work a little more than two years ago and its development has been observed with interest by many within and without the industry.

Grays Harbor Dedicates Terminal

The first unit of the Grays Harbor port terminals at Hoquiam, Wash., was dedicated on Sept. 30, marking the first step in port development conceived more than eleven years ago. The improvements provide a central pier, 2,000 ft. long by 300 ft. wide, with a large transit shed. Slips on either side of the central pier are 300 ft. and 400 ft. wide, respectively, 2,000 ft. long and dredged to a depth of 28 ft. at mean low water. Railroad tracks run the length of the pier, which has storage space for 28,000,000 ft. b.m. of lumber.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

FEDERATED AMERICAN ENGINEERING SOCIETIES, Washington, D. C.; Annual meeting Washington, Jan. 11-12, 1923.

AMERICAN ROADBUILDERS ASSOCIATION, New York City; Annual Convention, Chicago, Jan. 15-18.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York City; Annual meeting, New York City, Jan. 17 and 18.

AMERICAN CONCRETE INSTITUTE, Detroit; Annual Convention, Cincinnati, Jan. 22-26.

ASSOCIATED GENERAL CONTRACTORS OF AMERICA, Washington, D. C.; Annual meeting Los Angeles, Jan. 30-Feb. 3.

The Western Society of Engineers has an effective and unique annual get-together meeting of officers and members of its twenty-two standing and special committees. Eighty engineers Oct. 26 listened to the schedule of proposed work the chairmen were to present in three- and five-minute reports. The program committee has found too many meetings have been provided and has cut the number to one a week. In finances the society is more than living within its income. The library serves daily 15 to 50 inquirers and is buying $500 worth of new books. The noon-day luncheons which more or less failed last year are to be revived with high-class speakers. The young men's forum has a series of talks on economics planned. Most interest centers around the public affairs committee which has 56 members assigned to nine sub-committees covering all phases of civic activity which have an engineering slant.

PERSONAL NOTES

Hon. G. D. MACLEAN, Provincial secretary for British Columbia, has been appointed Minister of Railways for that province, in place of Hon. John Oliver who recently resigned.

SIR HENRY W. THORNTON, recently appointed president and general manager of the Canadian National Rys., sailed for England on Oct. 14. He will resign his position as general manager of the Great Eastern Ry. and will return to Canada to enter upon his duties in about a month.

GEORGE G. WALD has resigned as city engineer of Venice, Calif., effective Nov. 1, and will be succeeded by J. B. GRIFFIN, formerly with the American Trona Corp.

J. H. GWYN, chief engineer of the Denver, Rio Grande and Western R.R., was chosen as chief engineer for the Denver Terminal Ry., in the election of officers of that company held Oct. 12. He will serve both companies.

VINCENT KELLEY was recently appointed superintendent of streets at Winsted, Conn.

E. E. SANDS, formerly city engineer of Houston, Tex., has been appointed by the mayor a member of the City Plan Commission. The other members are M. E. Tracy, a newspaper editorial writer; J. B. Jackson, a real estate dealer, and H. L. Cole, an attorney.

THE C. C. JONES CONSTRUCTION CO., general contractors, Charleston, W. Va., announce the admission to partnership of A. G. Higginbotham, formerly of Higginbotham, Knapp and Haviland, architects. The business will be conducted under the firm name of HIGGINBOTHAM & JONES, general contractors and builders.

F. L. COOPER who has been serving as extension agent of Conejos County, Colorado, has been appointed a specialist in agricultural engineering at the state agricultural college, Fort Collins. F. R. LAMB takes the place in Conejos County made vacant by Mr. Cooper's promotion.

M. L. KINGSLEY, who has had charge of design and construction of the Selfridge and Co. extension in London, England, has returned to Chicago to take up similar work with Graham, Anderson, Probst & White, architects, of that city.

DOUGLAS L. MCLEAN, a graduate in civil engineering at McGill University, Montreal, has been appointed Deputy Minister of Public Works for Manitoba. He has held several important positions and was recently chief engineer of the Manitoba Drainage Commission.

A. B. CUTTER, president of the port commission and city engineer of Everett, Wash., has been granted a six months' leave of absence during which time he will take a course at the National Institute of Public Administration in New York City. Mr. Cutter served with the A. E. F. during the World War, being first commissioned as a first lieutenant and assigned to the 18th Engineers, Railway. Eventually he was appointed section engineer of Base Section 6, A. E. F., and stationed at Marseilles, France.

CHARLES M. REPPERT, chief engineer, Bureau of Engineering of the Department of Public Works, Pittsburgh, Pa., has resigned to enter private practice. His definite future plans will be announced after his return from an extended trip he is now making to the Pacific Coast. Mr. Reppert was connected with the Engineering Department of the City of Pittsburgh from the time he graduated from Cornell University as civil engineer in 1904 until just before the war, having charge of the sewer work of the city in the latter years of his service. During the war he was deputy chief engineer of the Housing Division of the United States Shipping Board which built so many of the small cities and housing developments in connection with the government shipyards. After the war he entered the firm of Morris Knowles, Inc., consulting engineers in Pittsburgh, where he stayed until about a year ago when he accepted the position from which he has just resigned.

GEORGE C. BROWN, of Lufkin, Texas, has been appointed county engineer of Hardin County, Texas. Mr. Brown was appointed county engineer of Liberty County when the precincts voted $1,700,000, but the entire issue was not approved by the attorney-general. As a result of his new appointment he will not be an applicant for the place with Liberty County when the bond matter is straightened out.

L. N. COPE & SON has been dissolved as a contracting-engineering firm of Decatur, Ill., Roy M. Cope and L. N. Fisher having purchased the interest of the senior member of the firm, L. N. Cope. The firm will hereafter be known as COPE & FISHER.

ROBERT A. ALLEN has been appointed state engineer of Nevada and ex-officio member of the Nevada State Public Service Commission for the unexpired term of Col. James G. Scrugham, democratic nominee for Governor of Nevada. Col. Scrugham was appointed March 28, 1919, for a four-year term. Mr. Allen has served as deputy state engineer for three and one-half years.

ROLLEN J. WINDROW, former chief engineer of the Texas Highway Department and at present consulting engineer with the Missouri State Highway Commission, has acquired an interest in the contracting business of Smith Bros., general contractors, Dallas, Tex. Mr. Windrow is actively connected with the business as chief engineer. He still maintains his connection with the Missouri State Highway Commission retaining an office in Kansas City, and dividing his time between that work and private business in Texas. Smith Bros. is one of the largest general contracting firms operating in Texas, having under contract about $10,000,000 worth of work, including highway construction, street paving, sewer and water-works installations, levee, irrigation and railroad work.

A. ANTOINE, engineer of Ponts et Chaussées, of Strasbourg, France, has recently returned to his home after an extended visit through the eastern part of the United States inspecting American engineering projects in the field in which his department is interested.

J. W. STONE, formerly assistant valuation engineer of the Pennsylvania R.R. system, has been appointed valuation engineer, effective Oct. 1, 1922. He takes the place of C. A. Preston, whose death was noted in these columns recently. Mr. Stone was born in Philadelphia and educated at Treemont Seminary, Norristown, Pa. Like many other officers of the Pennsylvania, Mr. Stone began his railroad career as a rodman in the engineering department. He was seventeen years of age when he entered the service. After four and one-half years in the engineering department he was transferred to the operating department, serving successively as transitman, assistant supervisor, supervisor and division engineer at various points on the lines east of Pittsburgh and Erie. In May, 1915, Mr. Stone was appointed assistant valuation engineer of the Pennsylvania R.R., Lines East, and served in that capacity until his present appointment.

P. H. DEVINE of Hidalgo County, Texas, has been appointed highway engineer for Starr County. He is stationed at Rio Grande City.

FRED. D. KING, attached to the engineer's office of the city of New Orleans, has resigned to accept a position with the Louisiana State Highway Department. Mr. King will be connected with the maintenance department, with headquarters at Monroe, La. Mr. King has been in the city engineer's office for nearly seven years.

H. P. HEVENOR has joined the staff of Dwight P. Robinson & Co., Inc., New York, as consulting engineer. Until recently he was a member of the firm of Engel & Hevenor, Inc., where he specialized in track construction, taking part in numerous large projects in the East, Middle West and South. Mr. Hevenor is a member of the A.S.M.E., Brooklyn Engineers Club, New England Street Railway Association, the A.R.E.A., and other associations.

OBITUARY

DR. R. B. FITZRANDOLPH, chief of the hygienic laboratory of the New Jersey State Department of Health, died at his home in Trenton Oct. 22, aged 50 years.

MAJOR SAMUEL P. HATFIELD, retired civil engineer, died Oct. 22 of heart disease in Brooklyn, aged 85. For nearly fifty years he had been engaged in river and harbor improvement work under the Corps of Engineers, United States Army.

HUGH MONTGOMERY COPELAND, well known in engineering circles in Brooklyn, N. Y., died suddenly on Oct. 19. He was 45 years old and a native of Brooklyn. He received his early training in the Brooklyn Polytechnic Institute and was graduated from the Rensselaer Polytechnic Institute, Troy, N. Y., in 1904.

THOMAS H. MCCANN, at one time city engineer of Hoboken and a consulting engineer of that city, died Oct. 25, age 76 years. He had been identified with public improvement work in Hoboken practically most of his professional career, having had much to do with the design of the first tunnel under the Hudson River. Later he designed and superintended the erection of many of Hoboken's wooden shipping piers and acted as consultant when those piers were replaced with fireproof structures. Other structures which he designed and erected were two truck elevators, one at Hoboken and the other at Weehawken for elevating freight from the river. Later he became a member of the engineering firm of Beyer & McCann, of Hoboken. He was a member of the American Society of Civil Engineers, having been elected in 1890.

DURWARD B. KENNEDY, president of the firm of Kennedy & Smith, Inc., contractors of Flushing, Long Island, died Oct. 23, at his home in Flushing, age 56 years.

From the Manufacturer's Point of View

A Point of Contact Between Maker and User of Construction Equipment and Materials

Equipment Makers and Users Confer on Standards

Leading Manufacturers and Contractors on Joint Committee Begin Important Program

Washington Correspondence

WORK has been begun by the joint committee of construction equipment manufacturers and members of the Associated General Contractors of America on the suggestions recently put forward regarding standardization. For the next few weeks the committee will consider the suggestions from the experience of its own members and by means of correspondence with other contractors and manufacturers. By Dec. 1 there will probably be a meeting of the committee to go over the plans and present at least some of the results in concrete form.

The suggestions cover a wide range, from specifications for shovels to a standard capacity, even if not standard material, for concrete mixers, hoisting engines and other heavy equipment for various classes of construction. At the recent conference where the appointment of this committee was agreed upon, it was stated, for instance, that there are 2,000 possible variations of a simple hand-shovel.

It is hoped at least to bring forward specifications which will enable manufacturers to know what prospective purchasers want for a particular job and to enable contractors to order intelligently, thus reducing costs to both.

MEMBERS OF COMMITTEE

The joint committee is composed of C. E. Bement, Novo Engine Co., Lansing, Mich., chairman; H. B. Bushnell, Western Wheeled Scraper Co., Aurora, Ill.; Philip Koehring, Koehring Co., Milwaukee; F. H. King, Marion Steam Shovel Co., Marion, O.; C. D. McArthur, Blaw-Knox Co., Pittsburgh; H. H. Baker, Sterling Wheelbarrow Co., Milwaukee; and H. M. Howard, General Motors Truck Co., representing the manufacturers. In addition, the contractors are represented on the committee by Stanley D. Moore, Moore & Young, Waterloo, Ia.; W. A. Rogers, Bates & Rogers, Chicago; A. P. Greensfelder, Fruin-Colnon Contracting Co., St. Louis; W. G. Will, Samuel Gamble Co., Erie, Pa.; C. W. Lundoff, Cleveland; Frederick L. Cranford, Brooklyn; W. A. Waldridge, Detroit, and Gen. R. C. Marshall, Jr., Washington.

September Motor Truck Output 27% Above Last Year

Reports of the U. S. Department of Commerce record that motor-truck production in September, 1922, was 27 per cent above September, 1921, though showing an expected decline from summer business. The output for September this year was 18,843, for August this year 24,200 and for September, 1921, 13,648.

Winter Buying of Pipe Evokes Discussion by Water-Works Men

Since the publication of the article in the Oct. 19 issue of *Engineering News-Record* (p. 675), many water-works engineers have expressed their views on the proposal, made by the manufacturers, to spread purchases of cast-iron pipe throughout the 12 months of the year by winter buying. A continuation of the discussion begun in last week's issue follows:

C. R. HENDERSON
Manager, Davenport (Ia.) Water Co.

The pipe makers are now and at this season of the year usually are behind in filling their orders. Many private water companies and some forehanded municipalities place orders early in the year for spring delivery, thereby gaining some advantage in price. If this practice is not general enough to equalize manufacture it might be possible for water departments in the South to lay pipe during the winter months, but any effort to induce water-works people in the North to lay pipe between Nov. 1 and April 1 would fail because the weather is so unreliable that plans cannot be made with certainty and so pipe gangs are laid off, the men seeking inside work for the winter.

The winter would seem to be a good time for pipe makers to fill up their yards with made pipe and this they doubtless do. We are all interested in any plan that will make for economy in manufacture and delivery of pipe, and are willing to consider any suggestions of the makers which will bring about improved conditions.

J. A. JENSEN
Supervisor, Water Works Department, Minneapolis

Regarding seasonal buying of cast-iron pipe, there is no doubt that the situation might be relieved if the demand could be spread over the year. Some of our spring orders have not yet been filled and in smaller cities around Minneapolis it is impossible, for the present, to get pipe at all.

To purchase pipe in advance might involve a risk in loss by changes in price, and there is usually a financial burden to be carried by the purchaser unless payments are deferred. A price differential would probably solve this problem.

In this latitude frost interferes with winter work. When frost penetrates 4 to 6 ft. it is useless to attempt work of this kind unless high costs are ignored.

GEORGE G. EARL
General Superintendent Sewerage and Water Board, New Orleans

In New Orleans we have not the usual reasons for seasonal work to anything like the same extent as in the North, and our work goes ahead just about the same all year round. We do have more rainy days, but the advan-

(*Continued on p. 766*)

Gary Sees Prosperous Future for American Industry

In his presidential address before the American Iron and Steel Institute at its meeting in New York City, Oct. 27, Judge Elbert H. Gary, chairman of the board, United States Steel Corp., forecast a period of prosperity in American industry.

"There are no obstacles to continued prosperity in the iron and steel business of the United States," said Judge Gary, "except such as may arise from interference with the natural course of supply and demand. Steel is needed immediately for buildings and other structures, for railroads, for farms, automobiles, airplanes and many other purposes. Order books are well filled, finished steel, aggregating many thousand tons, is stored at the producing mills, ready for shipment, and this notwithstanding the recent labor troubles at the mines and in transportation."

After announcing that steel manufacturers are now producing about 75 per cent of their capacity Judge Gary commented on the general business situation. "As to general business conditions," he continued, "in addition to what has already been said, great significance should be given to the publications concerning the enormous savings bank balances. These show conclusively a disposition to economize, whatever may be the reasons. Economy and saving are fundamental to thrift and prosperity."

Touching upon the present labor shortage Judge Gary advocated a change in restrictions on immigration. He said, in part: "These laws ought to be promptly changed. The restrictions upon immigration should be directed to the question of quality rather than numbers of foreigners coming to this country. Measures for limiting the number of immigrants to those who are clearly shown to be healthy, morally, politically and physically, ought to be clear, strict and enforceable; but the number allowed to come here should be equal to the necessities of our industries. The administration of the law could be under the control of a competent and impartial governmental commission or department to be managed for the benefit of the general public and not for the protection of any special class or the exploitation of any impractical or injurious theory. This is one of the most important questions now debated throughout the nation."

Crushed Stone Association to Hold Convention

The National Crushed Stone Association will hold its next annual convention in Chicago, Jan. 15-17, at which time and place the convention of the American Road Builders' Association and the Good Roads Show will be in session. Although the details of the program have not yet been announced, quarry operation and management will be topics of central interest and will be covered by contributed papers and discussion from the floor. The program committee consists of Nathan C. Rockwood, editor, *Rock Products*, chairman; W. Scott Eames, president of the association; William H. Hoagland, president, Marble Cliff Quarries Co., Columbus, Ohio; John Sloan, secretary, Wisconsin Granite Co., Chicago; and A. P. Sandles, secretary of the association.

Discuss Winter Buying of Pipe

(*Continued from p. 765*)

tage of cooler weather offsets this disadvantage. Our ground never freezes to help delivery conditions over soft ground, and often this constitutes one of our greatest difficulties.

As suggested in the article, a reduced price for winter delivery would doubtless be a strong consideration to influence the users of pipe to stock up as far as possible during the winter.

WILLIAM W. BRUSH
Deputy Chief Engineer, Department of Water Supply, Gas and Electricity
New York City

The main reasons for the present rather general practice of buying pipe when needed, rather than anticipating pipe demands, are: (1) Cost of rehandling pipe from point of freight delivery to storage yard, and from storage yard to site of work. (2) Lack of funds with which to make purchases materially in advance of use of materials. (3) Lack of authority for city officials to pay for pipe cast and stored at foundries on account of municipal contracts. Pipe so cast cannot be paid for until delivered to the city. (4) Uncertainty of future demands for various sizes of pipe.

My personal belief is that these reasons, either individually or collectively, are not sufficient to warrant the larger cities delaying their purchases until the spring or summer months. If the larger cities should place their contracts for pipe with the foundries so as to permit of the fabrication and delivery of the pipe during the winter months, the greater part, if not the entire output, of the foundries would be taken during the winter as well as during the summer months. We in New York have endeavored, but in general unsuccessfully, to secure our appropriations early in November to permit of placing our contracts in November or December, and securing our pipe during the winter so as to have a relatively large stock on hand at the beginning of the working season. This is true, however, only of the smaller sizes of pipe, as the larger sizes are generally furnished directly to the contractor and the contractor has no storage space within which to place his pipe. For the larger pipe, I doubt whether it would be feasible for a city like New York to have the pipe cast during the winter.

From the viewpoint of laying the pipe during the winter we find it to be impracticable on account of frost conditions, the increased cost of the work, the uncertainty as to the extent to which the cost will be increased by frost and the annoyance occasioned by opening a street during the winter and having to delay the completion of the work and the backfilling of the street on account of frost.

If the manufacturers of pipe should offer purchasers a price differential during the winter months, which frequently they do at the present time, this would materially aid in securing orders for the manufacture of pipe during the winter period. We have just made an estimate of something over $1,000,000 as the amount required for our extension of small pipe next year, and we hope to get the appropriation in time to have the greater part of the material required fabricated and delivered by the time the spring work opens.

[*Further discussion next week*]

Business Notes

MICHIGAN VALVE & FOUNDRY CO., Detroit, has purchased the business and assets of the Flower Valve Manufacturing Co., Detroit, including patterns, designs and patents. With present manufacturing facilities increased by the installation of additional machinery the Michigan company will continue the manufacture of its line of hydrants, sluice-gates, valves and heavy industrial castings.

C. A. JENNINGS, district sales manager at Chicago for the Wallace & Tiernan Co., Inc., has resigned, effective Nov. 1, to become Chicago manufacturer's sales representative for the Michigan Valve & Foundry Co., of Detroit; Roberts Filter Manufacturing Co., of Darby, Pa.; Universal Destructor Co., of Pittsburgh, and other firms manufacturing water-works and sanitary engineering equipment.

AMERICAN ROCK ASPHALT CORP., Pittsburgh, Pa., has been incorporated, under the laws of Delaware, at a capitalization of $3,000,000.

PAUL J. KALMAN CO., Chicago, manufacturers of building products and distributors of reinforcing steel, has recently changed its corporate name to KALMAN STEEL CO., under which its present executive organization and policies are to be continued.

WILLIAM B. WOOD, president of Gifford-Wood Co., Hudson, N. Y., manufacturer of excavating and conveying machinery, died Oct. 28 at the Albany City Hospital, after a two weeks' illness. Mr. Wood was born in Arlington, Mass., July 15, 1869. He became a member of the firm of William T. Wood & Co., of Arlington upon the death of his father Cyrus in 1896 and continued as a partner with William E. Wood, and later as a member of Gifford-Wood Co. when incorporated in 1905. He moved with his family to Hudson in 1911 and succeeded Malcolm Gifford as president upon the latter's death in 1919.

RICHARD HORN, who for the last four years has been district sales representative at Portland, Ore., for the Cleveland Tractor Co., has resigned to represent Bear Tractors, Inc., New York, as district sales manager on the Pacific Coast.

JOHN W. WOOLEY, vice-president, Minneapolis Equipment Co., distributor for the Jaeger Machine Co., Columbus, Ohio, was killed in Ironwood, Mich., last month. Mr. Wooley was the innocent victim of a stray bullet fired during a quarrel between two other men. He had previously served several years as sales manager of the Oshkosh Manufacturing Co.

WALTER S. MCKEE has resigned as vice-president and director of the American Manganese Steel Co. and will develop the business of the Inland Engineering Co. of Chicago, of which he is president.

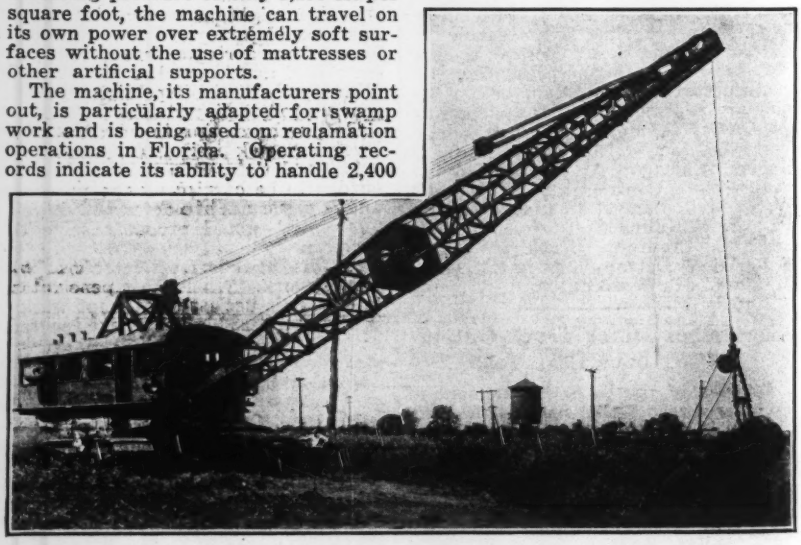
Equipment and Materials

New Dragline Has 60-Ft. Boom and 2½-Yd. Bucket

A dragline excavator of the full revolving type, mounted on two multi-pedals and equipped with a 250-hp., six-cylinder heavy-duty type of gasoline engine, is announced by the Austin Machinery Corp., Chicago. Semi-Diesel engines can be substituted if desired. Standard equipment is a 2½-cu.yd. Page bucket and a 60-ft. boom. With a bearing pressure of only 1,150 lb. per square foot, the machine can travel on its own power over extremely soft surfaces without the use of mattresses or other artificial supports.

The machine, its manufacturers point out, is particularly adapted for swamp work and is being used on reclamation operations in Florida. Operating records indicate its ability to handle 2,400 cu.yd. of material in 10 hr. It has a low speed forward of ½ mile per hour and a high speed forward of ¾ mile per hour.

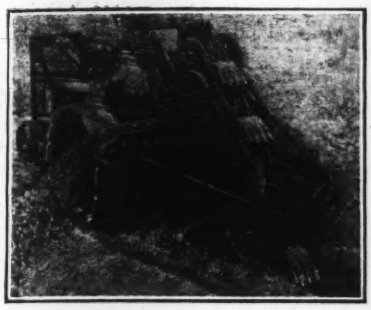
An air compressor and storage tank, the former operated through a direct connection to the main motor, supply the air rams which control the drag and hoist drums, the swinging mechanism of the machine and an air starter for the main motor. Machines of this type are ordinarily worked day and



night so that electric lights constitute a part of the equipment. One detail of the equipment on machines shipped into hot climates is an electric fan which serves both to cool the operator and blow mosquitoes away.

Light-Weight Ditcher Mounted on Fordson Tractor

By Jan. 1 the Charles T. Topping Machinery Co., Pittsburgh, will be in a position to start deliveries on its new light-weight pony ditcher designed as a general purpose trenching machine. The equipment consists of a framework carrying an endless chain of excavating buckets mounted on a standard Fordson tractor which supplies power both for traction and for trench digging. The working length of the machine is 16 ft., its width 7 ft. 2 in., and wheel base 92½ in. Its weight complete, with tractor, is 6,900 lb. and it is designed to excavate a trench from 12 to 18 in. wide and 48 in. deep. Fuel



consumption is given by the manufacturers as approximately 2¾ gal. of kerosene per hour.

Excavated material from the buckets is delivered on a 12-in. wide conveyor belt at right angles to the digging boom. This conveyor discharges the earth at the side of the machine and about 5 ft. from the center line of the trench. The conveyor may be reversed to discharge on either side.

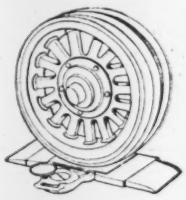
The digging buckets are of electric manganese steel with sides extending through the chains forming the inside link, thus making the bucket sides a part of the chain. A hardwood board, spring mounted, extends up the digging boom back of the buckets to increase the carrying capacity by preventing dirt from falling through.

The motor of the Fordson tractor is a four-cylinder, 25.6-hp. unit using either gasoline or kerosene. Power for digging is transmitted from the engine through the standard Fordson power take-off assembly, on which a special steel socket is substituted for the belt pulley.

The pony ditcher, its manufacturers state, is not intended to replace the more powerful machines of large capacity and heavy weight. It is intended primarily to perform a service which has heretofore been done largely by hand. The ditcher may be readily mounted or dismounted from the tractor, permitting the tractor to be used for general hauling. The ditcher can be readily converted from the center type to the offset type without special tools by shifting the excavator boom sideways.

Portable Scale Weighs Trucks Without Jacking

The State of Pennsylvania is using the portable scale illustrated herewith in the enforcement of its motor vehicle laws. The feature of the device, which has been developed by H. C. Berry, of the University of Pennsylvania at Philadelphia, is its elimination of the process of jacking up a truck to determine its weight. The scales are semi-automatic. One is set in each wheel track. The front wheels of the truck are then driven slowly across the tilting platform without stopping. The hand on the maximum - pressure reading dial indicates and retains the weight reading. The rear wheels are weighed in the same manner, and since they are always heavier than the front wheels it is not necessary to reset the hand on the dial.

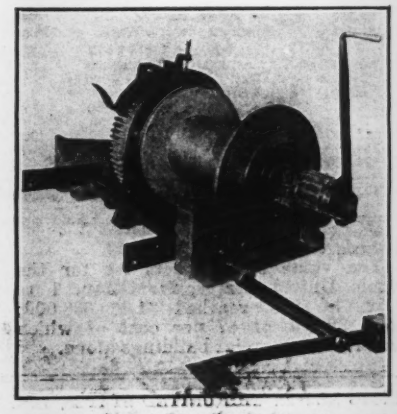


The capacity of the Berry scale as used in Pennsylvania is 15,000 lb. The scale is only 2¾ in. high and weighs 64 lb. The scale, with approach blocks and steel plate, may be packed in a case 18 x 7 x 30 in.

(*Editor's Note*—It is understood that the firm of Black & Decker, Baltimore, have patents pending for a similar device.)

Hoisting Engines Improved by Several New Features

Several new features have been incorporated in the design of its hoisting engines by the J. S. Mundy Hoisting Engine Co., Newark, N. J. Non-burning friction blocks of "asbestall," instead of wooden blocks which were apt to burn out, are now being employed on the frictions of hoists, especially those designed for long lifts at high speeds. Another innovation is the coring out of the brake flanges, producing openings through which air can circulate and cool the brakes. This feature



THIRD-DRUM HOIST ATTACHMENT

of design is employed usually on hoists for heavy-duty steel derricks where a rapidly descending boom must be caught by the brakes. The brake bands are equipped with "asbestelm" brake lining.

On its electric hoists the Mundy company is using a patented brake to prevent accidents by falling loads in case of failure of the supply of electric current. In such an event the brake functions automatically, holding the load in mid-air.

By the use of the third-drum extension, shown in the accompanying photograph, a double-drum hoist may be adapted to work involving the use of an excavating bucket or dragline. The third drum may be incorporated as a part of existing hoisting engines by bolting it onto the main frame.

Another recent innovation designed to increase the service of any two- or three-drum hoisting engine is a patented swinging drum for operating the bull-wheel of a derrick. This device, like the third drum extension noted in the previous paragraph, may be attached to existing hoisting engines, without necessitating a separate swinging engine.

Publications from the Construction Industry

Truck Mounted Crane—BYERS MACHINE Co., Ravenna, Ohio, features its "Truckrane" in an illustrated bulletin just issued. The equipment consists of the company's autocrane model No. 1, which has a special base to permit of its being mounted on a motor truck, thus combining light crane service with ability to move quickly from one job to another. The company furnishes the crane unmounted; it can be used on any standard truck of 5 tons capacity or larger having a minimum chassis length of 8 ft. 10 in. from rear of driver's seat to center of rear axle. The outfit has an operating radius of 20 ft. and uses a ½-yd. clamshell bucket. The weight of the crane without bucket or counterweight is 11,200 lb. The boom is of the latticed panel type, 25 ft. long. Power for operating the crane is supplied by a four-cylinder, 35-hp. Hercules gasoline engine. The crane has a capacity of 5,000 lb. at 10-ft. radius and 2,500 lb. at 22-ft. radius. The bulletin illustrates the use of the crane in handling sand and crushed stone, coal and broken asphalt.

Business Analysis—WILLIAM H. RANKIN Co., advertising agents, Chicago, has compiled from Government and other sources a book of statistics for business men. For each county in the United States are shown the values of bonds, crops, and manufactures. There is also a tabulation, by counties, of the white population, number of automobiles registered, and mileage of all roads. The figures for surfaced roads are recorded separately. An estimate also has been made of the income tax paid by the people of each county. The summary of statistics for each state includes, in addition to the items given for the counties, a record of climatic conditions. The information is presented in two loose-leaf volumes with flexible leather bindings. The price is $200.

Hardwood Lumber—HARDWOOD MANUFACTURERS' INSTITUTE, Chicago, has issued a 30-p. booklet entitled "Waste Elimination in the Production and Consumption of Hardwood Lumber." Much of the text is devoted to explaining the purpose of rules in grading and inspecting hardwood lumber and to forest conservation.

Business Side of Construction

Facts and Events that Affect Cost and Volume

October Contracts Nearly Equal September Total

Gains In Waterworks, Sewers, Excavations and Industrial Works—Total for Ten Months Over Billion

Contracts awarded in the United States and Canada, on important engineering projects, during the month of October, reached a total of $137,877,000 as against $138,648,000 in September. This comparison indicates the reluctance, on the part of an unparalleled construction boom, to yield even to seasonal diminution.

The minimum costs observed in Construction News, from which these tables were compiled, on each class of construction, are as follows: water-works, $15,000; other public works, $25,000; industrial construction, $40,000 and commercial buildings, $150,000.

Lettings in the Middle Atlantic States during October, aggregated $34,302,000, or 25 per cent of the total for the United States and Canada. The Middle West came next with $32,801,000, or 24 per cent.

Contracts let on waterworks, during the month, increased 95 per cent over September awards; industrial construction increased 70 per cent and sewers, 48 per cent. Excavating and dredging during October, more than doubled the lettings for the preceding month.

Bridges, streets and roads, commercial buildings and miscellaneous construction fell off slightly from the September levels. Federal Government awards dropped only $640,000.

The value of contracts let for the whole United States, from Jan. 1 to Nov. 1, 1922, reached $1,309,593,000; $612,182,000, or 47 per cent of which was for commercial buildings alone.

Engineering News-Record Construction Cost Index Number

November, 1922	188.60
October, 1922	188.60
November, 1921	166.32
Peak, June, 1920	273.80
1913	100.00

Engineering News-Record's Construction Cost Index Number is exactly the same as last month, due to stability in prices of steel, cement and lumber. Steel is now $2.00 per 100 lb., Pittsburgh mill. The average rate for common labor remains at 45c. Thus, general construction cost is 13 per cent higher than one year ago and 31 per cent under the peak; it is 88.6 per cent above the 1913 level.

Engineering News-Record Construction Volume Index Number

Monthly	
October, 1922	127
September, 1922	129
October, 1921	109
1913	100
Yearly	
1921 (entire year)	88
1920 (entire year)	91
1913	100

Engineering News-Record's Construction Volume Index Number is 127 for the month of October, and 88 for the whole of 1921, as against 100 for 1913. This means that the actual volume of construction in 1921 (not the mere money value of the contracts let that year) is 12 per cent under the volume of construction for 1913. Our monthly volume number, 127 for October, 1922, is really the increment of construction, and indicates the rate at which contracts are being let as compared with 1913 awards.

Outlook Favors Continuance of Building Activity

A. G. C. Expects Demand for Building to Continue with Resulting Rise in Construction Costs

That construction costs will continue to increase to a higher level than at present, and that the demand for construction will continue for some years to come, is the opinion of the Associated General Contractors of America, in a statement made today to James A. Wetmore, acting supervising architect, who is quoted as authority for the statement that within the next eighteen months the country may look for a very material drop in the cost of building. In the *United States Advertiser* it is reported that $15,000,000 worth of federal buildings throughout the country are

VALUE OF CONTRACTS LET IN THE UNITED STATES AND CANADA IN OCTOBER, 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Canada	Total
Waterworks	.....	.....	$185,000	$799,000	$5,945,000	$7,000	$750,000	$7,686,000
Sewers	$189,000	$1,240,000	63,000	1,868,000	1,441,000	153,000	42,000	4,996,000
Bridges	241,000	21,000	223,000	179,000	462,000	773,000	.....	1,899,000
Excavating and dredging	25,000	22,000	509,000	393,000	1,051,000	365,000	25,000	2,390,000
Streets and roads	635,000	4,729,000	2,521,000	3,138,000	7,487,000	3,702,000	950,000	23,162,000
Industrial works	9,795,000	10,729,000	2,200,000	6,825,000	929,000	850,000	251,000	31,579,000
Buildings	4,407,000	15,687,000	4,262,000	18,411,000	7,670,000	4,639,000	738,000	55,814,000
Federal Government	2,117,000	1,319,000	1,510,000	15,000	302,000	1,766,000	.....	7,029,000
Miscellaneous	50,000	555,000	491,000	1,173,000	172,000	519,000	362,000	3,322,000
Total	$17,459,000	$34,302,000	$11,964,000	$32,801,000	$25,459,000	$12,774,000	$3,118,000	$137,877,000

VALUE OF CONTRACTS LET IN THE UNITED STATES, JAN. 1 to NOV. 1 1922

	New England	Middle Atlantic	Southern	Middle West	West of Mississippi	Western	Total
Waterworks	$2,754,000	$5,972,000	$2,787,000	$5,627,000	$10,844,000	$4,421,000	$32,405,000
Sewers	548,000	9,576,000	3,647,000	15,450,000	4,412,000	2,599,000	36,232,000
Bridges	2,311,000	13,214,000	5,865,000	4,801,000	6,283,000	3,213,000	35,687,000
Excavating and dredging	118,000	918,000	7,942,000	1,486,000	3,674,000	2,803,000	16,941,000
Streets and roads	10,275,000	69,379,000	58,766,000	73,236,000	50,577,000	34,066,000	296,099,000
Industrial works	30,524,000	48,720,000	20,525,000	47,617,000	8,632,000	8,452,000	164,470,000
Buildings	51,557,000	233,185,000	36,436,000	182,269,000	58,228,000	50,507,000	612,182,000
Federal Government	2,658,000	15,258,000	7,657,000	1,698,000	2,694,000	8,818,000	38,783,000
Miscellaneous	5,057,000	45,064,000	3,761,000	7,658,000	7,290,000	7,964,000	76,794,000
Total	$105,602,000	$441,286,000	$147,386,000	$339,842,000	$152,634,000	$122,843,000	$1,309,593,000

being held up for a drop in the cost of construction expected within the next eighteen months.

Not only has the cost of building been going up for several months, according to the Associated General Contractors, but so has the cost of materials. Wages in the building trades have more recently begun to increase also. The general average of wholesale prices has been increasing since the first of the year.

"The behavior of all these prices in increasing during a time of recovery from business depression" declare the contractors, "is entirely normal. It is a phenomenon which always occurs during like periods. We believe it is a very strong indication that prices in general have been stabilized for the present on a new price level in the neighborhood of 70 per cent higher than that which prevailed in 1913. This means that prices will continue to go up until the present period of prosperity is fully established and will not go down again until the beginning of the next business depression. The next depression will probably be only a moderate one—such as we were familiar with before the war—and will be accompanied by only moderate decreases in prices.

"Instead of expecting that building costs will be materially lower eighteen months from now, we anticipate that they will continue to increase during the greater part of that period, and that they will be at that time, perhaps, at about the beginning of a decrease but at a point higher than the present. We believe, further, that the decrease which may be expected to begin at about that time will not go to a point very much below the figures reached during the past winter."

In explaining the reasons for their opinions, the contractors say that the costs of building materials are going up partly because they are partaking of the general tendency of prices to rise during this part of the economic cycle, and partly because we are experiencing a building boom of unprecedented volume. Wages of building labor are increasing partly because of the shortage brought about by this same building boom and partly because of a recovery in other lines of industrial activity, which is already beginning to produce labor shortages.

"One important aspect of this phe-

(*Concluded on p. 770*)

Labor Rates and Conditions Throughout the Country

Improved business conditions and increased employment, together with a shortage of common labor and an unusually heavy demand for skilled mechanics in nearly all trades, are the outstanding features of today's labor market.

In its survey of current industrial conditions throughout the country, the National Industrial Conference Board states: "The tendency of wages during the last two months has been distinctly upward. Labor shortages have developed during the past few months in face of only a moderate upward swing in industry. This has served as a warning that labor is not to be had in sufficient quantities. The industries of the United States are undoubtedly going through a period of nation-wide wage adjustment. The high wages in the coal mining industry, on the railroads, in the building trades and in other favored industries have set a high standard. Less-favored industries—both men and managers—realize their position. The voluntary wage increases that have been made in a large number of industries are indicative of this general leveling up. Wage increases in such basic industries as iron and steel, cotton, textile and the like, will inevitably be converted into higher prices."

Local industrial conditions as reported by *News-Record* correspondents are given as follows:

Atlanta—Unsettled situation of a month ago somewhat eased up since strike settlements. Lack of cars still a retarding factor in resumption of normal industrial activities.

Cleveland—Hod carriers awarded 75c. as against 60c. and common laborers 57½c.@75c. as compared with a maximum of 57½c. per hr., one month ago.

Dallas—Sufficient skilled building trades mechanics to meet all demands.

Denver—No unemployment. Building season longer than usual owing to clear, warm weather.

Detroit—Supply of all trades about equal to demand. Little unemployment.

Kansas City—Scarcity of carpenters; paid $1.12½ as against $1.07½ per hr., last month. Fair supply of bricklayers but some idle hoisting engineers, pile drivers and structural iron workers. Very few unemployed hod carriers.

Montreal—Minimum wage for common labor now 35c. as against old rate of 30c. per hr.

New Orleans—Labor conditions stable. Building boom at peak.

New York—Still some degree of unemployment existing, particularly in clerical occupations. Increased activity in manufacturing. Building retarded by shortage of materials, due to freight congestion. Distinct labor shortage in skilled trades. Unskilled common laborers receive minimum of 45c. with a maximum of 62½c. per hr. on certain construction projects. Average pay for pick and shovel men in building construction about 60c. per hr.

Philadelphia—Scarcity of bricklayers, carpenters, hodcarriers and common laborers. Fair supply of other trades. Carpenters receive maximum of $1 as against 90c.; common laborers, 35c.@45c. as compared with 35c.@40c. per hr., one month ago.

St. Louis—Bricklayers scale, $1.25 per hr. but men being paid $1.37½.

(Higher rates indicated by +, decreases by—)

Cities	Bricklayers	Carpenters	Hoisting Engineers	Hod Carriers	Pile Drivers	Structural Iron Workers	Common Labor
Atlanta	$0.90	$0.70	$0.70	$0.30	.....	$0.65	$0.30@.35
Baltimore	1.25	.80	.87½@.90	.60@.75	$0.75	1.00	.35@.40
Birmingham	1.00	.75	.50@1.00	.15@.25	.....	1.00	.15@.20
Boston	1.12½	1.00	1.00	.....	1.00	1.00	+.55
Cincinnati	1.25	.95	.95	.72½	.....	.95	.35
Chicago	1.10	1.00	1.10	.....	1.10	1.05	.72½
Cleveland	1.25	1.10	1.10	+.75	.91	1.10	+.57½@.75
Dallas	1.00	1.00	1.00	.60	1.00	1.00	.25
Denver	1.25	1.00	1.00	.75@.81½	1.00	1.03½	.35@.50
Detroit	1.12½	.80	.80@.90	.50@.60	1.00	.60@.80	.50
Kansas City	+1.12½	1.00	1.00	.70	1.00	1.00	.35@.60
Los Angeles	1.25	1.00	1.00	1.12½	.87½	1.00	.56½@.62½
Minneapolis	1.00	.80	.80	.65	.....	.80	.35@.50
Montreal	.90	.65	.50	.35	.50	.55	+.35
New Orleans	1.00	.85	.90	.50	.80	1.00	.35@.40
New York	1.25	1.12½	1.25	.87½	1.00	1.12½	+.45@.60
Pittsburgh	1.30	1.12½	1.00	.90	1.00	1.00	.50
St. Louis	1.25	1.10	1.12½	.85	1.12	1.12½	.30@.40
San Francisco	1.12½	1.00	1.00	.75	1.00	1.12½	.47½@.50
Seattle	1.00	.80	.90	.70	1.00	.80@.90	.50@.60
Philadelphia	1.25	+.90@1.00	+.90@1.00	.75@.90	1.00	.90@1.00	+.35@.45

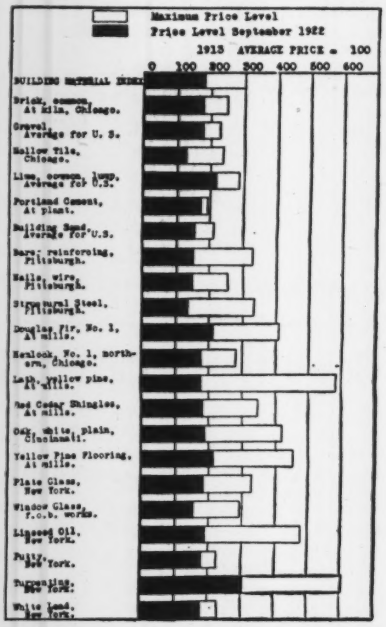
(Concluded from p. 769)

nomenon" they state, "is the shortage of common labor, which is due, in large measure, to the almost complete extinction of immigration for the past nine years, caused first by the Great War and latterly by our present restrictive immigration act. That this shortage of common labor in fields other than the building trades is a very real one is proved by the recent action of the United States Steel Corporation, and a number of the other important steel companies, in making large voluntary increases in their wage scales.

"It may be that some believe the present building boom has about run its course, and that, for that reason, building activity will soon diminish and building costs go down. We believe the outlook to be far otherwise. The boom shows no sign of abating. For six successive months the figures for contracts let have been record-breaking. The slight recession of August is less than the usual seasonal recession. As a result of very painstaking investigations it has been estimated that the deficit in building, the country over, is so great that building could continue for ten successive years, beginning with this year, at 25 per cent above normal before catching up with that deficit. We do not predict any such sustained activity, but we do point to the figures as proof that there is no possibility of the present building boom coming to an end within the next few months, because of having completely filled the demand for new construction."

Lower Wholesale Prices in September

The September level of wholesale prices was slightly below that of August, according to latest information gathered in leading markets of the country, and issued Oct. 19 by the U. S. Department of Labor through the Bureau of Labor Statistics. Measured by the Bureau's weighted index number which includes 404 commodities or price series, there was a decrease from August to September of 1½ per cent, or from 155 to 153.


Maximum Price Level
Price Level September 1922
1913 AVERAGE PRICE = 100
0 100 200 300 400 500 600
BUILDING MATERIAL INDEX
Brick, common, At kiln, Chicago.
Gravel, Average for U. S.
Hollow tile, Chicago.
Lime, common, lump, Average for U.S.
Portland Cement, At plant.
Building Sand, Average for U.S.
Bars, reinforcing, Pittsburgh.
Nails, wire, Pittsburgh.
Structural Steel, At mills.
Douglas fir, No. 1, At mills.
Hemlock, No. 1, northern, Chicago.
Lath, yellow pine, At mills.
Red Cedar Shingles, At mills.
Oak, white, plain, Cincinnati.
Yellow Pine Flooring, At mills.
Plate Glass, New York.
Window Glass, f.o.b. works.
Linseed Oil, New York.
Putty, New York.
Turpentine, New York.
White Lead, New York.

Farm products showed an increase of 1½ per cent over the August level. Cloths and clothing increased 1 per cent, chemicals and drugs 1½ per cent, building materials 4½ per cent, and metals and metal products 6½ per cent in average price in the period stated. In the group of miscellaneous commodities there was an increase of less than 1 per cent.

On the other hand, a decrease of approximately 10 per cent took place in the important group of fuel and lighting materials, due to decreases in bituminous coal and coke. No change in the general price level was reported for foods and house furnishings.

The considerable increase shown for building materials and for metals and metal products is due largely to advances in structural steel and other articles included in both groups.

Comparing prices in September with those of a year ago, as measured by changes in the index numbers, it is seen that the general level has risen 8½ per cent. Fuel and lighting materials show by far the largest increase, 34¾ per cent. Building materials and metals and metal products increased approximately 15½ per cent, farm products 7½ per cent, and cloths and clothing 2¾ per cent in price in the year.

Monthly Prices of Construction Materials

Ups and Downs of the Market

Pig Iron—Production increasing with the lowering of coke prices. No. 2 foundry iron down $1 in Chicago, $1.50 in Pittsburgh and $3 in Philadelphia. Basic, $2.50 lower in Pittsburgh and $4.50 in Philadelphia. Bessemer declined 50c. in Pittsburgh and gray forge, $1 per ton in Philadelphia, during month. Prices slowly receding.

Railway Supplies—Maximum on light rails, $47 as against $45 per ton, f.o.b. Pittsburgh; advanced 20c. per 100 lb. at Birmingham. Re-rolled rails, $28@$32 as compared with $26@$29 per ton at Pittsburgh mills, one month ago. Red oak ties slightly lower in St. Louis. Track bolts up 10c., spikes, 15c. and section angle bars, 35c. per 100 lb., Pittsburgh. Track supplies higher in St. Louis. Railroads buying heavily.

Pipe—Wrought-pipe discounts reduced two points on Pittsburgh basing card of Oct. 19; equivalent to rise of $4 per ton on both black and galvanized steel pipe. Mill advance reflected in lowering of discounts in New York and Cleveland warehouses. Cast-iron pipe, 6-in., up $2.50 per ton at Birmingham mill, during month, despite lower pig-iron and fuel costs. Sewer pipe higher in Philadelphia and New Orleans but lower in St. Louis. Clay drain tile, however, $5 per 1,000 lin.ft. higher, in St. Louis.

Road and Paving Materials—Road oils up ½c. in New York and 1c. per gal. in St. Louis. Mexican petroleum situation also responsible for advances in bulk asphalt, of $1 in Baltimore, Atlanta and Philadelphia and $2 per ton in New York. Wood paving blocks up 5c. per sq.yd. in New York; down 40c. in Philadelphia.

Sand, Gravel and Crushed Stone—Gravel, $2 as against $1.75 in New York and $2@$2.25 as compared with $2 per cu.yd. in Detroit, one month ago; sand prices unchanged. Crushed stone, up 10c. in Detroit and 20c. per cu.yd. in Atlanta. Transportation conditions and local labor adjustments responsible for advances.

Lime—Hydrated finishing lime up 20c. in St. Louis, 50c. in Philadelphia and $1 per ton in New York. Hydrated common, up 50c. in Philadelphia and $2 in St. Louis. Lump finishing lime advanced 50c. per ton in Philadelphia. Common lump lime 5c. per bbl. higher, in Atlanta; advanced 50c. per ton in Philadelphia and $3 in Baltimore. Hydrated finishing lime, however, down $3.50 per ton in Minneapolis; common lump also reduced 10c.@15c. per bbl.

Cement—Price advances made during acute coal situation have receded to meet winter demand. Mill prices down 5c. at Mason City, Ia.; 15c. in Fordwick, Va.; 25c. in Mitchell, Ind., Hudson, N. Y. and Northamption, Pa., and 30c. at La Salle, Ind. Mill drop reflected in following declines: f.o.b., New York, 25c.; Toledo, 5c.; Peoria, 2c.; Cedar Rapids, 3c. and Cincinnati, 8c. per bbl. Montreal and Philadelphia, however, quote rise of 10c. per bbl., during month.

Structural Steel—Steel plate demand for car, tank, ship and boiler construction, in excess of production. Plates quoted at minimum of $1.90, with maximum at $2.25, or an average price of about $2 per 100 lb., f.o.b. Pittsburgh. Shapes quoted, however, at $2@$2.10 and bars at $2@$2.15, f.o.b. mill.

Brick and Hollow Tile—Common brick, $14@$15.50 as against $15@$17 per M. wholesale, alongside dock, New York, one month ago. Kansas City also quotes reduction of 50c. per M. Prices, however, slightly higher in Detroit and Philadelphia. Hollow tile up in Kansas City, Philadelphia and St. Louis. Declines due to seasonal falling off in demand; but unusually large amount of brick construction under way, for this time of the year, in some sections.

Lumber—Production sharply curtailed by transportation difficulties; but prices steady in the face of lessened buying activities. Yellow pine structural timbers, base sizes, up 50c. in Kansas City and Philadelphia; $1 in Minneapolis; $2 in Detroit and $5 per M. ft. b.m. in Dallas. Douglas fir up $2 in Kansas City and $6 in Dallas; down $2 in Minneapolis and Denver. Hemlock, higher in Kansas City but cheaper in Denver and Minneapolis. No change in spruce.

Scrap—Market weaker. St. Louis, however, quotes higher prices on all grades except cast scrap.

Explosives—Dynamite, 40 per cent gelatin, down 1c. in Seattle and 2c. in Minneapolis and St. Louis; up ½c. per lb. in Philadelphia.

Linseed Oil—Quiet; few changes.

Price advances since last month are indicated by **heavy type**; declines by *italics*

PIG IRON—Per Gross Ton—Quotations compiled by The Matthew Addy Co.:

	Current	One Year Ago
CINCINNATI		
No. 2 Southern (silicon 2.25 @ 2.75)	**$31.55**	$24.50
Northern Basic	**33.27**	22.52
Southern Ohio No. 2 (silicon 1.75 @ 2.25)	34.27	23.52
NEW YORK, tidewater delivery		
Southern No. 2 (silicon 2.25 @ 2.75)	36.27	30.26
BIRMINGHAM		
No. 2 Foundry (silicon 2.25 @ 2.75)	27.50	20.00
PHILADELPHIA		
Eastern Pa., No. 2X, (2.25@2.75 sil.)	*33.64*	22.76
Virginia No. 2 (silicon 2.25 @ 2.75)	37.17	28.74
Basic	*29.50*	20.75
Gray Forge	*32.00*	21.75
CHICAGO		
No. 2 Foundry Local (silicon 1.75 @ 2.25)	*31.00*	22.70
No. 2 Foundry Southern (silicon 2.25 @ 2.75)	**33.50**	26.66
PITTSBURGH, including freight charge from the Valley		
No. 2 Foundry Valley (silicon 1.75 @ 2.25)	*33.50*	22.96
Basic	*30.00*	21.96
Bessemer	*32.50*	21.96

RAILWAY SUPPLIES

STEEL RAILS—The following quotations are per ton f.o.b. Pittsburgh and Chicago for carload or larger lots. For less than carload lots 5c. per 100 lb. is charged extra:

	Pittsburgh				
	Current	One Year Ago	Birmingham	Chicago	St. Louis
Standard bessemer rails	$43.00	$45.00	.....	$43.00	43.00
Standard openhearth rails	43.00	47.00	$43.00	43.00	43.00
Light rails, 8 to 10 lb	45@47	1.65@1.75*	2.00*	43.00	41.00
Light rails, 12 to 14 lb	45@47	1.65@1.75*	2.00*	43.00	41.00
Light rails, 25 to 45 lb	45@47	1.65@1.75*	2.00*	43.00	41.00
Rerolled Rails	28@32	.....	.....	.....	.....

*Per 100 lb.

RAILWAY TIES—For fair-sized orders, the following prices per tie hold:

	6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Chicago, White Oak	$1.40	$1.55
Chicago, Hardwood and Red Oak	1.25	1.40
Chicago....Empty Cell Creosoting (add'l)	.45	.50
San Francisco..... Green Douglas Fir	.92	1.19
San Francisco, Empty Cell Creosoted, Douglas Fir	1.93	2.39
St. Louis, Red Oak*	*0.80*@1.30	*1.00*@1.60
St. Louis (creosoted) (zinc treated)	1.65	2.00

TRACK SUPPLIES—The following prices are base per 100 lb. f.o.b. Pittsburgh for carload lots, together with the warehouse prices at the places named:

	Pittsburgh					
	Current	One Year Ago	Chicago	St. Louis	San Francisco	Birmingham
Standard spikes, ⅜-in. and larger	$2.75@3.00	$2.30@2.40	$2.55	$3.02½	$4.45	$3.29
Track bolts	3.85@4.50	3.25@3.55	3.65	4.02½	5.45	4.29
Standard section angle bars	2.75	2.75	2.40	2.92½	4.10	2.94

PIPE

WROUGHT PIPE—The following discounts are to jobbers for carload lots on the latest Pittsburgh basing card:

BUTT WELD

Inches	Steel Black	Steel Galv.	Inches	Iron Black	Iron Galv.
1 to 3	66	54½	¼ to 1¼	34	19

LAP WELD

¼	59	47½	2	29	15
2½ to 6	63	51½	2½ to 4	32½	19
7 to 8	60	47½	4½ to 6	32½	19
9 to 12	59	46½	7 to 12	30	17

BUTT WELD, EXTRA STRONG, PLAIN ENDS

1 to 1¼	64	53½	¼ to 1¼	34	20
2 to 3	65	54½			

LAP WELD, EXTRA STRONG, PLAIN ENDS

2	57	46½	2	30	17
2½ to 4	61	50½	2½ to 4	33	21
4½ to 6	60	49½	4½ to 6	32	20
7 to 8	56	43½	7 to 8	25	13
9 to 12	50	37½	9 to 12	20	8

STEEL PIPE—From warehouses at the places named the following discounts hold for steel pipe:

	Black		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	57%	62½%	61½%
2½ to 6 in. lap welded	54%	59½%	58½%

	Galvanized		
	New York	Chicago	St. Louis
1 to 3 in. butt welded	44%	48½%	51½%
2½ to 6 in. lap welded	41%	45½%	50½%

Malleable fittings, Class B and C, from New York stock sell at list less 10%. Cast iron, standard sizes, *32-5%* off.

CAST-IRON PIPE—The following are prices per net ton for carload lots:

	Birmingham Mill	New York Current	New York One Year Ago	Chicago	St. Louis	San Francisco
4 in.	$45.50	$60.30	$52.30@53.30	$52.70	$44.50	$55.00
6 in. and over	43.00	55.30	47.30@48.30	48.70	.....	51.00

Gas pipe and Class "A," $4 per ton extra; 16-ft. lengths, $1 per ton.

CLAY DRAIN TILE—The following prices are per 1000 lin.ft.:

Size, In.	New York Current	New York One Year Ago	St. Louis	Chicago	San Francisco	Dallas
3	$45.00	$40.00	$40.00	$50.00	.....	$55.00
4	55.00	50.00	40.00	60.00	$76.50	65.00
5	80.00	80.00	75.00	80.00	97.75	84.00
6	105.00	105.00	75.00	100.00	127.50	110.00
8	170.00	175.00	170.00	150.00	212.50	181.00

SEWER PIPE—The following prices are in cents per foot for standard pipe in car load lots, f.o.b., except as otherwise stated:

Size, In	New York Delivered	Pittsburgh	Birmingham	St. Louis	Chicago	San Francisco	Dallas
3	$0.14	$0.105	.....	.....	$0.12	$0.12	.....
4	.14	.105	$0.10	$0.0875	.12	.15	$0.18
5	.20	.1575	.125	*.1025*	.18	.18	.165
6	.20	.1575	.150	*.1225*	.18	.21	.26
8	.34	.245	.225	*.20*	.28	.30	.35
10	.51	.3675	.2925	*.28*	.42	.42	.....
12	.65	.4725	.3825	*.36*	.54	.54	.80
15	1.03†	.63	.5625	*.52*	.72	.90	.....
18	1.50†	.875	.765	*.68*	1.00	1.32	.....
20	1.80†	1.05	1.0125	*.92*	1.20	.....	.....
22	2.40†	1.40	1.2375	.....	1.60	.....	.....
24	2.70†	1.575	1.4625	*1.20*	1.80	2.16	2.40
27	4.50†	2.795	....	*2.25*	3.75†	3.00	.....
30	5.00†	3.076	....	*2.70*	4.75†	3.60	.....
33	6.50	4.14	....	3.35	5.50†	.....	.....
36	7.50†	4.715	....	3.65	6.00†	.....	.....

	3	5	8	12	24	36
Boston	.....	.....	.....	.....	.....	.....
Minneapolis	.....	.....	$0.40	$0.72	$2.55	$5.66†
Denver	$0.135*	$0.18*	.27	.47	1.70	.....
Seattle	.13	.....	.325	.65†	2.34†	.....
Los Angeles	.....	.....	.....	.....	.....	.....
New Orleans	.1120*	.168*	.28	.476	1.82†	.....
Cincinnati	.111*	.1665	.259	.4995	1.665	3.7925†
Atlanta	.10*	.14*	.225	.425	1.55	.....
Montreal, *delivered*	.68‡	.45†	.70	1.35	4.50†	.....
Detroit	.102	.153	.238	.459	1.98†	6.15†
Baltimore	.1225	.2275	.35	.6870	2.29	5.23
Kansas City, Mo.	.135	.19	.30	.54	2.16	.....
Philadelphia	.114	.1755	.266	.513	1.71†	3.895†

*4-in., 6-in., 9-in., respectively. †Double Strength. ‡3-in. special.

ROAD AND PAVING MATERIALS

ROAD OILS—Following are prices per gallon in tank cars 8,000 gal. minimum f.o.b. place named:

		Current	One Year Ago
New York, 45% asphalt	(at terminal)	$0.06	$0.05½
New York, 65% asphalt	(at terminal)	.06	.05
New York, binder	(at terminal)	.06½	.08
New York, flux	(at terminal)	.06½	.06½
New York, liquid asphalt	(at terminal)	.07	.06½
St. Louis, 50@60% asphalt (*f.o.b.*) *Wood River, Ill.*		.04½	.01½*
Chicago, 40-50% asphalt		.05½	.05
Chicago, 60-70% asphalt		.05½	.05½
Dallas, 40-50% asphalt		.10	.10
Dallas, 60-70% asphalt		.13	.13
Dallas, 75-90% asphalt		.15	.15
San Francisco, binder, per ton		13.00†	15.00†

* Freight $21.75 per ton to Whiting, Ind.
† F.o.b. Oleum, Cal. Freight to San Francisco, 80c. per ton.

ASPHALT—Price per ton in packages (350-lb. bbls. or 425-lb. drums) and in bulk in carload lots, f.o.b. points listed:

	Package	Bulk
New York (*Mexican*)	$20.00	$16.00
Boston (*Mexican*)	19.50	16.00
Chicago (*Stanolind*)	26.00	22.00
San Francisco, *f.o.b. refinery*, Oleum, Cal.	19.50*	13.00*
Dallas, (*Texas*)	35.00	27.00
Seattle "*D*" *grade* (*California*)	23.75	13.00†
Denver (*California*)	40.00	....
Minneapolis *f.o.b. Twin Cities* (*Mexican*)	*33.00*	*27.50*
St. Louis (*Mexican*)	26.00	22.00
Baltimore (*Mexican*)	20.00	16.00
Los Angeles, *at factory, Bakersfield* (*California*)	....	....
Montreal (*Mexican*)	28.00	21.00
Atlanta (*Mexican*)	23.00	17.50
Detroit (*Mexican*)	22.50	19.50
Cincinnati (*Mexican*)	22.50	19.50
Maurer, N. J. (*Trinidad and Bermudez*)	28.50	26.50
Maurer, N. J. (*Mexican*)	18.00	15.50
Philadelphia (*Mexican*)	20.00	16.00
Kansas City, *petroleum*	28.83	*22.80*

*Freight to San Francisco, 80c. per ton.

†F.o.b. Richmond, Cal.

NOTE—Barrels or drums are optional in most cities. About 6 bbls. to the ton, and from 4 to 5 drums.

PAVING STONE—

New York *delivered*	5-in. granite, 28@29 blocks per sq.yd.	$135.00 per M	
Chicago	About 4x8x4 dressed	3.35 sq.yd.	
	About 4x8x4 common	3.10 sq.yd.	
San Francisco	Basalt block 4x7x8	70.00 per M	
Boston	5-in. granite	no report	
Atlanta	Granite	2.10 sq.yd.	
Detroit	Granite, 26½ blocks per sq.yd.	100.00 per M	
Baltimore	Granite	2.00 sq.yd.	
Montreal *delivered*	Granite	100.00 per M	
New Orleans	Granite, 4 x 8 x 4	3.25 sq.yd.	
Cincinnati	Granite	3.84@4 sq.yd.	
St. Louis	4x8x4 dressed	3.10 sq.yd.	
	4x8x4 common	2.90 sq.yd.	
Kansas City	No. Granite	3.95 sq.yd.	
Philadelphia	Granite	128.00 per M.	

FLAGGING—

New York	Bronx, 5 ft.	$0.30@35	sq.ft.
	Manhattan, 4 ft.	.26	sq.ft.
	Queens, 5 ft.	.26	sq.ft.
	6x20-in. cross-walk	1.00	lin.ft.
Chicago	18 in. wide	.99	lin.ft.

CURBING—Bluestone per lineal foot, in New York, costs 77c.@85c. for 5x16 in.; 88c. for 5x18 in., in cargo lots. 5x18 in., 1.44c. per lin.ft. delivered in St. Louis. 6x18 in., Chicago, $2 per lin.ft.

WOOD BLOCK PAVING—	Size of Block	Treatment	Per Sq.Yd.
New York (*delivered*)	3	16	$2.14
New York (*delivered*)	3½	16	2.34
New York (*delivered*)	4	16	2.66
Boston	3½	16	2.32
Chicago	4	16	3.00@3.25
Chicago	3½	16	2.50
St. Louis	3½	16	2.00
St. Louis	4	16	2.00
Seattle	4	16	Off market
Minneapolis	3½	16	2.09
Atlanta	3½	16	2.30
New Orleans	3	16	1.70
New Orleans	3½	16	1.95
New Orleans	4	16	2.25
Dallas	4	18	3.90
Baltimore	3½	16	3.44
Montreal	4	16	4.50
Detroit	3	16	2.84
Detroit	4	16	3.00
Cincinnati	4	16	2.35
Kansas City	4	16	3.25
Philadelphia	3½	16	*2.60*

CONSTRUCTION MATERIALS

SAND AND GRAVEL—Price for cargo or carload lots to contractor is as follows, per cu.yd.:

	Gravel 1½ In. Current	Gravel 1½ In. One Year Ago	Gravel ¾ In. Current	Gravel ¾ In. One Year Ago	Sand Current	Sand One Year Ago
New York	$2.00	$2.00	$2.00	$2.00	$1.00	$1.25
Denver	1.75	2.50	1.75	2.50	0.75†	1.10
Chicago	2.25	1.65	2.25	1.65	2.25	1.65
St. Louis, *per ton*	1.40	1.30	1.45	1.25	1.20	1.20*
Seattle	1.00	1.50	1.00	1.50	1.00	1.50
Dallas	2.25	2.25	2.25	2.25	2.25	2.25
Minneapolis	1.75	1.50	1.75	1.50	1.00	0.50†
Cincinnati	1.40	1.87½	1.40	2.03	1.15	1.60
San Francisco	2.25	2.25	2.25	2.25	1.50	1.50
Boston	....	2.65	....	2.65	....	2.00
New Orleans	2.85	2.85	2.85	....	1.35	1.35
Los Angeles, per ton	....	1.35†	....	1.35†	....	1.20†
Atlanta, per ton	2.00	2.00	2.00	2.00	1.35	1.35
Detroit	2@2.25	2.00	2@2.25	2.00	2.00	2.00
Baltimore, per ton	1.40	1.40	1.60	1.60	0.70†	2.40
Montreal, per ton	1.25	1.25	1.50	1.50	1.25	1.25
Birmingham, per ton (Crushed slag used instead of gravel)					1.20	1.28
Philadelphia	1.70	....	1.75	....	1.65	....
Kansas City, per ton	2.00‡	....	2.00‡	....	0.66†	....

New York—Grit, $1.75 per cu. yd.

Los Angeles—Freight from quarry, 85c. per ton, and is included in above price.

* Fine white sand: Pacific, $5 per ton; Ottawa, $6.

† At pit.

‡ Per cu. yd.

CRUSHED STONE—Price for cargo or carload lots f.o.b. city, unless stated otherwise, is as follows, per cu.yd.:

	1½ In. Current	1½ In. One Year Ago	¾ In. Current	¾ In. One Year Ago
New York	$1.65	$1.80@1.90	$1.75	$1.80@1.90
Chicago	2.25	1.60	2.25	1.60
St. Louis *delivered*	2.10	1.55*	2.20	1.55*
Dallas	1.65	3.20	1.65	3.20
San Francisco	2.25	2.25	2.25	2.25
Boston, *delivered*	....	3.00*	....	3.00*
Minneapolis, *at plant*	2.00	2.00	2.25	2.25
Kansas City	2.00	2.75	*2.00*	2.75
Denver	3.50	3.50	3.50	3.50
Seattle *delivered*	3.00	3.00	3.00	3.00
Atlanta	2.10*	2.25*	2.10*	2.25*
Cincinnati *delivered*	1.55*	2.37½	1.55*	2.08
Los Angeles	....	1.60*	....	1.70*
Detroit	1.90@2*	1.90*	1.90@2*	1.90*
Baltimore	1.70*	1.75*	1.60*	1.65*
Montreal	1.50*	2.00*	1.90*	2.10*
Birmingham *delivered*	3.20	3.20	3.10	3.10
Philadelphia	1.75*	....	1.60*	....
Pittsburgh	2.85	....	2.85	....
Cleveland	3.00*	....	3.00*	....

*Per ton.

CRUSHED SLAG—Price of crushed slag in carload lots, per net ton, at plants:

	1½-In.	¾-In.	Roofing	Sand
Youngstown District	$1.30	$1.30	$2.00	$1.30
Steubenville District	1.40	1.40	2.00	1.40
Ironton District	1.40	1.40	2.00	1.40
East Canaan, Conn.	1.25	1.35	4.00	1.00
Easton, Catasaqua, Pa.	1.00	1.00	2.00	0.90
Birmingham, Ala.	*0.75*	0.75	0.75	0.25
Buffalo, N. Y., and Erie, Pa.	1.25	1.25	2.25	1.25
Cleveland, Ohio	1.20	1.20	....	1.00
Eastern Pennsylvania and Northern New Jersey	1.20	1.20	2.00	1.20
Western Pennsylvania	1.25	1.25	2.00	1.25

LIME—Warehouse prices:

	Hydrated, per Ton Finishing	Hydrated, per Ton Common	Lump, per Barrel Finishing	Lump, per Barrel Common
New York	$16.80@$17.17	$13.10	$3.63½*	$2.75@$3.13½*
Chicago	20.00	18.00	1.50†	1.40†
St. Louis	21.20	19.00	....	17.75‡
Boston	....	....	....	....
Dallas	25.00	....	....	2.50†
Cincinnati	14.80	12.30	....	10.75‡
San Francisco	22.00	16.00	....	1.75†
Minneapolis	*25.50*	22.00 (white)	1.70†	1.40†
Denver	24.00	....	....	2.70†
Detroit	18.00	16.00	....	17.00‡
Seattle *paper sacks*	24.00	....	2.80†	....
Los Angeles	....	....	....	....
Baltimore	21.00	15.75	....	15.00‡
Montreal	21.00	21.00	15.00‡	11.00‡
Atlanta	23.00	13.00	2.25†	1.85†
New Orleans	....	17.25	2.40†	....
Philadelphia	15.50	14.50	13.00‡	12.00‡
Kansas City	25.60	24.00	2.34†	*2.20*†

*Per 280-lb. bbl. (net). †Per 180-lb. bbl. (net). ‡Per ton—Refund of 10c. per bbl. Minneapolis quotes brown common lump lime; Kelly Is. white is *$1.55*, Sheboygan *$1.45*. New York quotes hydrated lime "on cars" in paper sacks; lump lime "alongside dealers docks" or "on cars."

NATURAL CEMENT—Price to dealers per bbl. for 500 bbl. or over, f.o.b., exclusive of bags:

	Current	One Year Ago
Minneapolis (Rosendale)	$2.80	$2.80
Kansas City (Ft. Scott)	1.75	1.60
Atlanta (Magnolia)	11.00 ton	11.00
Cincinnati (Utica)	1.72	1.77
Boston (Rosendale) per bag	....	0.85@0.95
St. Louis (Carney)	*1.75*	....

PORTLAND CEMENT—Prices to contractors per bbl. in carload lots f.o.b. points listed *without bags*. Cash discount not deducted.

	Nov. 2	One Month Ago	One Year Ago
New York, del. by truck	$2.60	$2.60@2.75	$2.40
New York, alongside dock to dealers	*2.30*	2.55	2.10
Jersey City	2.73	2.73	2.28
Boston	....	....	2.61
Chicago	2.20	2.20	1.97
Pittsburgh	2.24	2.24	2.02
Cleveland	2.46	2.46	2.28
Detroit	2.48	2.48	2.31
Indianapolis	2.41	2.41	2.23
Toledo	*2.48*	2.53	2.31
Milwaukee	2.37	2.37	2.19
Duluth	2.14	2.14	1.95
Peoria	*2.39*	2.41	2.14
Cedar Rapids	*2.45*	2.48	2.28
Davenport	2.43	2.43	2.22
St. Louis	2.35	2.35	2.25
San Francisco	2.71	2.71	2.84
New Orleans	3.30	3.30	2.88
Minneapolis	2.39	2.39	2.26
Denver	2.85	2.85	3.10
Seattle	2.90	2.90	3.10
Dallas	2.25	2.25	2.55
Atlanta	2.54	2.54	2.60
Cincinnati	*2.51*	2.59	2.37
Los Angeles	....	3.30	3.31
Baltimore	2.90	2.90	2.88
Pirmingham	2.40	2.40	2.27
Kansas City	2.85	2.85	2.45
Montreal	2.88	2.78	3.10
Philadelphia	2.51	2.41	....
St. Paul	2.39	2.39	2.26

NOTE—Bags 10c. each, 40c. per bbl.;

Current mill-prices per barrel in carload lots, without bags; to contractors:

Buffington, Ind.	$1.95	Mason City, Ia.	*$2.05*
Universal, Pa.	2.00	La Salle, Ind.	*2.05*
Steelton, Minn.	1.95	Hudson, N. Y.	*2.20*
Fordwick, Va.	*2.20*	Leeds, Ala.	2.20
Mitchell, Ind.	*2.05*	Hannibal, Mo.	2.10
Iola, Kan.	2.10	Lehigh Valley District	*2.10*

TRIANGLE MESH—Price per 100 sq.ft. in carload lots:

PLAIN 4-INCH BY 4-INCH MESH

Style Number	Weight in Pounds per 100 sq.ft.	Pittsburgh, Mill	Warehouse: New York	Chicago	Dallas	San Francisco
032	22	$0 85	$0.95	$0.92	$1.15	$1 20
049	28	1 08	1.23	1 18	1.46	1 55
068	35	1 31	1.48	1 43	1.80	1 89
093	45	1.69	1.91	1 84	2.30	2 43
126	57	2 08	2.35	2 27	2.86	3 00
153	68	2 48	2.81	2 71	3.40	.....
180	78	2 85	3.22	3 12	3.93	.....
245	103	3 76	4.25	4 11	5.15	.....
287	119	4 34	4.90	4 74	5.96	6.31
336	138	5 04	5.69	5 51	7.32	.....
395	160	5.84	6.60	6.38	8.00	.....
		PAVING				
036P	17	$0.65	$0.72	$0.71	$0.88	.....
053P	24	.91	1.02	.99	1.26	.....
072P	31	1 15	1.29	1 26	1.57	.....
097P	40	1 48	1.67	1 62	2.02	.....
049R	24	.91	1.02	.99	1.24	.....
067R	31	1 15	1 29	1.26	1.57	.....
089R	40	1.48	1.67	1.62	2.02	.....

In rolls 16-, 20-, 24-, 28-, 32-, 36-, 40-, 44-, 48-, 52-, and 56-in. wide and in 150-, 200- and 300-ft. lengths. Galvanized is about 15% higher. Size of roll carried in New York warehouses, 48 in wide x 150 f. long, or 600 sq. ft.

EXPANDED METAL LATH—Prices in carload lots per 100 yd. for painted are as follows:

Gage	Weight	*New York	Chicago	St. Louis	San Francisco	Dallas
27Dia.	2.3	$22 00	$23 25	$20.22	$20.78	$25 50
26 "	2.5	22.00	24 75	21 64	21.43	27 58
25 "	3.0	22.00	27 25	24 28	.....	30 71
24 "	3.4	24 00	29 25	26 10	24.28	33 16
22 "	4.33	27.00	33 75	31 60	.....	35 10

* Price to contractors at warehouse or delivered on job in Manhattan, Bronx or Brooklyn.

BARS, CONCRETE REINFORCING—Current quotations per 100 lb.:

ROLLED FROM BILLETS

Inches	Pittsburgh Mill	Birmingham Mill	Warehouse, Uncut: New York	Chicago	St. Louis	Dallas	San Francisco
½ and larger	$2 00@2.15	$2 35	$3 04	$2.80	2 75	$4 00	$3.00
⅝	2 05@2.20	2 45	3 09	2 85	2 80	4 05	3.05
¾	2 10@2.25	2 55	3 14	2.90	2 85	4 10	3.10
⅞	2 25@2.40	2 60	3 19	3 05	2 95	4 15	3.25
1	2 50@2.65	2 65	3 54	3 30	3 20	4 40	3.50

Includes 15c charge for cutting to lengths of 2 ft. and over.
Twisted bars cut to length take extra of 27½c. per 100 lb.

ROLLED FROM RAILS

	Chicago	St. Louis	Dallas		Chicago	St. Louis	Dallas
½ and larger	$2 10	$2.45	$3 50	⅝	$2 35	$2 75	$3 95
¾ in.	2 15	2 50	3 75	1	2 60	3 00	4 20
⅞	2 20	2 55	3 80				

BRICK—Contractors price per 1,000 in cargo or carload lots is as follows:

	Common: Current*	One Month Ago	One Year Ago	Paving Block: 3-inch*	4-inch*
New York (del.)	$16.90@18.55	$18.20@20.20	$18.40	$42 00†	$50.00†
New York (at dock)	14@15.50	15@17	15 00	.....	.....
Chicago	11 00	11.00	11 00	34 00	42 00
St. Louis, salmon	14 00	14.00	17 00	30.50	34.50
Denver, salmon	12 00	12 00	14 00	.....	.....
Dallas	10 90	10 90	12 72	no market	
San Francisco	15.00	15 00	18 00	.....	.....
Los Angeles (del.)	.....	15.00	15 50	(not used)	
Boston (del.)	.....	.....	17 00	44.00†	53 00†
Minneapolis (del.)	18@19	18@19	17.00	.....	43.00
Kansas City	14 00	14 50	14 50	.....	.....
Seattle	14 00	14 00	14 00	44 00	.....
Cincinnati	17 00	17 00	18.00	41 00	36.50
Montreal	16 00	16 00	16 00	.....	68 00
Detroit (del.)	16.50@17.50	16 50	17.00	36 50	39.50@41
Baltimore (del.)	20 00	20 00	20.00	36 00‡	.....
Atlanta	12 00	12 00	11.00	39.00	.....
New Orleans	15 75	15 75	14.00	.....	.....
Birmingham	12 50	12 50	11.50	.....	.....
Philadelphia	20@28	19@24	.....	40.00	48.00
Pittsburgh (del.)	16.00	16.00	.....	.....	.....
Cleveland	16.00	16.00	.....	.....	.....

* For paving blocks 3½x8½x3 and 3½x8½x4 respectively. † F.o.b. ‡ Vitrified, f.o.b. plant, Baltimore.

HOLLOW TILE—Price per block in carload lots to contractor for hollow building tile.

	New York: Current on Trucks*	One Year Ago	Chicago	Philadelphia	St. Louis	San Francisco	Perth Amboy N. J., Factory*
4x12x12	$0 1230	$0.11370	$0 0808	$0 12	$0 095	$0.108	.....
6x12x12	.1844	.15160	.1112	.....	.124	.156	.....
8x12x12	.2305	.20210	.1516	.1875	.174	.244	$0.2147
10x12x12	.....	.....	.1879	.....	.212	.....	.2653
12x12x12	.....	.....	.2147	.....	.242	.....	.3448

* 5 per. off for cash.

	4x12x12	8x12x12	12x12x12
Boston	.....	.....	.....
Minneapolis (f.o.b. cars)	$0 08	$0.13125	$0.23
Minneapolis (delivered)	.09	.14675	.245
Cincinnati	.1093	.1861	.....
Kansas City	.08	.15	.....
Denver	.065	.123	.188
Seattle (delivered)	.11	.25	.36
Los Angeles factory	.....	.....	.....
New Orleans	.12	.23	.36
Detroit (delivered)	.09	.175	.260
Montreal	.08	.15	.29
Baltimore	.14	.25	.39
Atlanta	.0776	.1453	.....
Dallas	.115	.....	.....
Birmingham	.11	.18	.....
Pittsburgh (del.)	.068	.128	.179
Cleveland	.08	.164	.....

San Francisco, Philadelphia, Atlanta, New York and Chicago quote on hollow partition tile.

STRUCTURAL MATERIAL—Following are base prices f. o. b. mill, Pittsburg and Birmingham together with quotations per 100 lb. from warehouses at place named:

	Pittsburgh, Mill	Birmingham Mill	New York	Dallas	St. Louis	Chicago	San Francisco
Beams, 3 to 15 in.	2.00@2.10	$2.40	$3.14	$4.20	$3.00	$3.02½	$3.25
Channel, 3 to 15 in.	2.00@2.10	2.40	3.14	4.20	3.00	3.02½	3.25
Angles, 3 to 6 in., ¼ in. thick	2.00@2.10	2 40	3 14	4 20	3.00	3.02½	3.25
Tees, 3 in. and larger	2.00@2.10	2 40	3 14	4 20	3.00	3.02½	3.25
Plates	2.00@2.25	2 40	3 14	4 50	3.00	3.02½	3 40

RIVETS—The following quotations are per 100 lb.:

STRUCTURAL

	Warehouse: Pittsburgh, Mill	New York: Current	One Yr. Ago	Chicago	St. Louis	San Francisco	Dallas
½ in. and larger	$3.15	$3.85	$3.70	$3.35	$3.85	$4.50	$6.00

CONE HEAD BOILER

½ in. and larger	3.25	3.95	3.80	3.45	3.95	4.60	6.15
⅝ and ¾	3.40	4.11	3.95	3.60	3.95	4.75	6.30
⅞ and 1	3.65	4.35	4.20	3.85	3.95	5.00	6.55

Lengths shorter than 1 in. take an extra of 50c. Lengths between 1 in. and 2 in. take an extra of 25c.

NAILS—The following quotations are per keg from warehouse:

	Pittsburgh, Mill	Chicago	San Francisco	Dallas	St. Louis	Montreal
Wire	$2.70	$3.10	$4.00	$5.00	$3.60	$4.95
Cut	3.00	5.50	5.65	7.75	6.00	5.00

PREPARED ROOFINGS—Standard grade rubbered surface, complete with nails and cement, costs per square, f.o.b., as follows:

	New York: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.	Philadelphia: 1-Ply l.c.l.	2-Ply l.c.l.	3-Ply l.c.l.
No. 1 grade	$2 10	$2 55	$3.00	$1 90	$2 35	$2 80
No. 2 grade	1.85	2.15	2 55	1 70	2 00	2.40

Slate-surfaced roofing (red and green) in rolls of 108 sq.ft. costs $1.95 per roll in carload lots and $2.20 for smaller quantities f.o.b. Philadelphia.

Single shingles, red and green slate finish, cost $5.50 per package (sufficient to cover 50 sq.ft.) in carloads; $5.75 in smaller quantities, in Philadelphia. Strip shingles (4 in 1) f.o.b. Philadelphia, l.c.l., $5.90

ROOFING MATERIALS—Prices f.o.b. New York:

Tar felt (14 lb. per square of 100 sq.ft.) per roll of 432 sq.ft.	$2.00
Tar pitch (in 400-lb. bbl.), per 100 lb.	1 65
Asphalt roofing (in barrels), per ton, f.o.b. plant*	40.50
Asphalt felt (light), per ton, f.o.b. plant*	64.50
Asphalt felt (heavy), per ton, f.o.b. plant*	68.50

* Delivered in Metropolitan Dist., $3.00 additional.

SHEETS—Quotations are per 100 lb. in various cities from warehouse also the base quotations from mill:

Blue Annealed	Pittsburgh, Large Mill Lots	St. Louis	Chicago	San Francisco	New York
No. 10	$2 50@$2.85	4.10	$4.00	$4.35	$4 19
No. 12	2.60@ 2.95	4.15	4.05	4.40	4 24
No. 14	2.70@ 3.00	4.20	4.10	4 45	4 29
No. 16	2.90@ 3.30	4.30	4.20	4.55	4.39
Black					
*Nos. 18 and 20	3.20@ 3.60	4.65	4.70	5 70	4 70
*Nos. 22 and 24	3.25@ 3.65	4.70	4 70	5 75	4 75
*No. 26	3.30@ 3.70	4.75	4 75	5 80	4 80
*No. 28	3.35@ 3.75	4.85	4.85	5.90	4.90
Galvanized					
No. 10	3.35@ 3.85	4.85	4.85	.....	4.90
No. 12	3.45@ 3.95	4.95	4.95	5.85	5 00
No. 14	3.45@ 3.95	4.95	4 95	5 85	5.00
Nos. 17 to 21	3.75@ 4.25	5.10	.....	6 15	5.30
Nos. 22 and 24	3.90@ 4.40	5.40	5 40	6 30	5 45
*Nos. 25 and 26	4.05@ 4.55	5.55	5 55	6 45	5.60
*No. 28	4.35@ 4.85	5.85	5 95	6 75	5.90

*For painted corrugated sheets add 30c. per 1,000 lb. for 5 to 28 gage; 25c. for 19 to 24 gages; for galvanized corrugated sheets add 15c., all gages.

LINSEED OIL—These prices are per gallon:

	New York: Current	One Year Ago	Chicago: Current	One Year Ago
Raw in barrel (5 bbl. lots)	$0.93	$0 72	$0 94	$0.72

WHITE AND RED LEAD—Base price in cents per pound:

	Red				White	
	Current		1 Year Ago		Current	Yr. Ago
	Dry	In Oil	Dry	In Oil	Dry or In Oil	Dry or In Oil
100-lb. keg	12 75	14 25	12 25	13 75	12 75	12 25
25 and 50-lb. kegs	13 00	14 50	12 50	14 00	13 00	12 50
12½-lb. keg	13 25	14 75	12 75	14 25	13 25	12 75
5-lb. cans	15 75	17 25	15 25	16 75	15 75	15 25
1-lb. cans	17 75	19 25	17 25	18 75	17 75	17 25

LUMBER

Prices wholesale, per M. ft. b.m., to dealers in carload lots, f.o.b.

San Francisco—Prices of rough Douglas fir No. 1 common, in carload lots to dealers at yards. To consumers, $2 per M ft. additional.

	6–8 and 12 Ft.	10–16–18 and 20 Ft.	22 and 24 Ft.	25 to 32 Ft.
3x3 and 4	$30 00	$33 00	$33 00	$35 00
3x6 and 8	30 00	33 00	33 00	36 00
4x4-6 and 8	30 00	33 00	34 00	37 00
3x10 and 12	30 00	35 00	34 00	38 00
3x14	34 00	35 00	36 00	38 00
4x10 and 12	30 00	33 00	34 00	37 00
4x14	34 00	35 00	36 00	38 00

	24 Ft. and Under	25 to 32 Ft.	33 to 40 Ft
6x10	$32 00	$35 00	$37 00
6x14	34 00	37 00	39 00
8x10	32 00	35 00	37 00
8x14	34 00	37 00	39 00

New York and Chicago—Wholesale prices to dealers of long leaf yellow pine.

	New York*		Chicago	
	20 Ft. and Under	22–24 Ft.	20 Ft. and Under	22–24 Ft.
3x 4 to 8x8	$47 00	$48 00	$45 00	$47 00
3x10 to 10x10	50 00	51 00	48 00	50 00
3x12 to 12x12	54 00	55 00	51 00	53 00
3x14 to 14x14	60 00	61 00	56 00	58 00
3x16 to 16x16	67 00	68 00	60 00	62 00
3x18 to 18x18	80 00	81 00	67 00	69 00
4x20 to 20x20	90 00	91 00	77 00	79 00

*Wholesale price to dealers; to contractors, delivered from lighters or cars to job, $5 additional. Short leaf pine up to 14 x 14 costs $15 per M. less.

Over 24 ft.—Add $1 for each additional 2 ft. in length up to 30 ft. for sizes 12 x 12 and under, for sizes over 12 x 12 add $2, for merchantable add $2 to sizes 10 x 10 and under. For pine add $2 to the price of merchantable for all sizes.

Other Cities	8 x 8-In. x 20 Ft. and Under			12 x 12-In. 20 Ft. and Under	
	P.	Fir	Hemlock Spruce	P.	Fir
Boston					
Seattle		$24 50			$24 50
New Orleans	$30 00			$35 00	
Baltimore	58 00			70 00	
Cincinnati	40 00			45 00	
Montreal	50 00	50 00	$35 00 $38 00	78 00	50 00
Los Angeles					
Denver		38 75	38 75 38 75		39 75
Minneapolis	47 00	39 75	*41 00*	**50 00**	39 75
Atlanta	37 00			42 00	
Dallas	**45 00**			**45 00**	
Kansas City	47 00	47 00	47 00 49 50	**49 50**	
Birmingham	28 00			36 00	
Philadelphia	**40 00**	38 08	45 00 50 00	**48 50**	40 00
Detroit	**44 75**	**46 75**		**53 75**	46 75
St. Louis	**44 00**			**51 00**	

	1-In. Rough, 10 In. x 16 Ft. and Under			2-In. T. and Gr. 10 In. x 16 Ft.	
	P.	Fir	Hemlock	P.	Fir
Boston					
Seattle		$20 00			$23 50
New Orleans, at mill	$70 00			$37 00	
Baltimore	40 00			40 00	
Cincinnati	65 00	80 00		37 50	
Montreal	66 00	45 00	$27 00	45 00	45 00
Los Angeles					
Denver		*30 25*	*30 25*		33 25
Minneapolis	**48 50**	*38 25*	*38 00*	43 75	*37 25*
Atlanta	24 00			**28 00**	
Dallas	37 50	**36 00**		**48 60**	
Kansas City	44 50	**40 50**	**39 25**	**43 75**	40 00
Birmingham	24 00			30 00	
Philadelphia	33 00	38 50	45 00	35 00	38 00
Detroit	**47 50**	**39 50**		**45 00**	*40 50*
St. Louis	**75 00**			**50 00**	

Montreal—Up to 32 ft.; over which, $3.00 per M. ft. increase up to 30 ft.

Birmingham—Quotes carload lots, f.o.b. sidings. *$1 50* additional per M. ft. to contractors.

Boston and Cincinnati—Prices to contractors in carload lots, f.o.b.

Denver—Quotes dealers prices to contractors on large projects.

St. Louis—Wholesale price to contractors, $7@$11 per M. ft. additional.

Seattle—Price to contractors, delivered.

Dallas—Wholesale to contractors, $10 per M. ft. additional.

FREIGHT RATES

On finished steel products in the Pittsburgh district, including plates, structural shapes, merchant steel, bars, pipe fittings, plain and galvanized wire nails, rivets, spikes, bolts, flat sheets (except planished), chains, etc., the following freight rates are effective in cents per 100 lb., in carloads of 36,000 lb.:

Baltimore	$0.315	Detroit	$0.295
Birmingham	.69	Kansas City	.735
Boston	.365	New Orleans	.515
Buffalo	.265	New York	.34
Chicago	.34	Pacific Coast (all rail)	1.50†
Cincinnati	.295	Philadelphia	.325
Cleveland	.215	St. Louis	.43
Denver	1.275*	St. Paul	.595

*Minimum carload, 40,000 lb.

†Minimum carload, 50,000 lb., structural steel only; 80,000, lb. for other iron or steel products.

CONTRACTORS' SUPPLIES

STEEL SHEETPILING—The following price is base per 100 lb. f. o. b. Pittsburgh, with a comparison of a month and a year ago:

Current	One Month Ago	One Year Ago
$2.50	$2.50	$1.80@1.90

WIRE ROPE—Discounts from list price on regular grades of bright and galvanized are as follows:

	Eastern Territory New York and East of Missouri River
Hercules red strand, all constructions	25%
Patent flattened strand, special and cast steel	25%
Patent flattened strand, iron rope	10%
Plow steel round strand rope	40%
Special steel round strand rope	35%
Cast steel round strand rope	27½%
Round strand iron and iron tiller	10%
Galvanized steel rigging and guy rope	12½%
Galvanized iron rigging and guy rope	+7½%

California, Oregon, Nevada and Washington Discount 5 points less than discount for Eastern territory.

Wyoming, New Mexico and Colorado: Discount 5 points less than discount for Eastern territory.

Arizona: Discount 10 points less than discount for Eastern territory.

Montana, Idaho and Utah: Discount 10 points less than discount for Eastern territory.

North Dakota, Nebraska, Kansas, Oklahoma and Texas: Discount 5 points less than discount for Eastern territory.

MANILA ROPE—For rope smaller than ¾-in. the price is ½ to 2c. extra; while for quantities amounting to less than 600 ft., there is an extra charge of 1c. The number of feet per pound for the various sizes is as follows: ¾-in., 8 ft., ¾-in., 6; ¾-in., 4½; 1-in., 3½; 1½-in., 2 ft. 10 in.; 1¼-in., 2 ft. 4 in. Following is price per pound for ¾-in. and larger, in 1200-ft. coils:

Boston		New Orleans	$0.17½
New York	$0.17	Los Angeles	.18
Chicago	.19	Seattle	.17½
Minneapolis	**.20½**	St. Louis	.30
San Francisco	*.16*	Montreal	.20
Atlanta	.20	Detroit	.19
Denver	.20	Baltimore	.17
Cincinnati	.19	Kansas City	.19½
Dallas	.29	Birmingham	.20
Philadelphia	**.18¾**		

EXPLOSIVES—Price per pound of dynamite in small lots:

	Gelatin 40%	Gelatin 60%
New York	$0.27	$0.30
Boston		
Kansas City	.2225	.2525
Seattle	*.165*	.195
Chicago	.245	.275
Minneapolis	*.189*	*.209½*
St. Louis	*.22*	*.24*
Denver	.2025	.2325
Dallas	.29	.375
Los Angeles		
Atlanta	.2525	.2825
Baltimore	.195	.225
Cincinnati	.23	.25
Montreal	.195	.235
Birmingham, *delivered*	.19	.21
New Orleans	.235	.265
San Francisco	.195	.235
Philadelphia	**.2475**	**.28**

PILES—Prices per lineal foot, pine piles with bark on, f.o.b. New York.

Diameters	Points	Length	Barge	Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.13	$0.17½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	0.17½	0.22
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	0.19½	0.24
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	0.23	0.32
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	0.25	0.34
14 in.—2 ft. from butt	5 in.	80 to 89 ft.	0.32	0.38

SCRAP—The prices following are per gross ton paid to dealers and producers f.o.b. New York. In Chicago and St. Louis the quotations are per net ton and cover delivery at the buyer's works, including freight transfer charges.

	New York	Chicago	St. Louis
No. 1 railroad wrought	$14 50	$11 50	**$16 00**
Stove plate	13 50	12 00	**15 50**
No. 1 machinery cast	18 00	16 50	*19 00*
Machine shop turnings	9 00	4 00	10 00
Cast borings	12 00	5 50	*10 50*
Railroad malleable cast	15 00	12 50	19 00
Re-rolling rails	16 00	13 00	**19 50**
Relaying rails	28 50	30 00	**23@32**

SHIP SPIKES—Current prices per 100 lb.:

In.	San Francisco Galv.	San Francisco Black	Seattle Black
½	$6.75	$5.50	$8.55
⅝	6.30	5.05	8.25
¾	6.15	4.90	8.30

Pittsburgh base in lots of 200 kegs or more $3.25@3.75.